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CONSERVATION OF RESOURCES IN MUNICIPAL WASTE

C. E. Scarsbrook, et al

Auburn University
Auburn, Alabama

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CONSERVATION OF RESOURCES
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This final open-file report (SW-13rg.of) on work performed under solid waste management research grant no. EC-00243 to Auburn University was prepared by C. E. SCARSBROOK, RAY DICKENS, A. E. HILTBOLD, HENRY ORR, KENNETH SANDERSON, *and* D. G. STURKIE *and is reproduced as received from the grantee.*

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Garbage composts utilized in the study were products of the Municipal Compost Plant of the City of Mobile, Alabama.

The research on all parts of the report, except on ornamental horticultural crops, was conducted by Ray Dickens, A. E. Hiltbold, C. E. Scarsbrook, and D. G. Sturkie of the Department of Agronomy and Soils, Auburn University Agricultural Experiment Station. Research on ornamental crops was conducted by Henry Orr and Kenneth Sanderson of the Horticulture Department, Auburn University.

D. G. Sturkie was principal investigator of the project from April 1, 1967 until his retirement on June 30, 1968. C. E. Scarsbrook was principal investigator from July 1, 1968 to the conclusion of the grant on March 31, 1970.

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CONSERVATION OF RESOURCES IN MUNICIPAL WASTE

This project had as a broad objective the determination of means of conservation and utilization of the resources contained in garbage compost. Utilization in soil and in greenhouse potting mixtures was the principal means of recycling the resources in the compost. Compost, except as noted, was obtained from the Municipal Compost Plant of the City of Mobile, Alabama.

The compost was produced from garbage after most of the metals, rags, and large items of refuse were removed by hand or by mechanical means. The remaining material was ground in a hammer mill and composted in windrows. The composition varied with season, fineness of grinding or screening, and duration of composting.

Two products of the Mobile plant were used. The first was a coarse ground compost containing a large quantity of plastic. This product will be referred to as original compost (oc) and is the material utilized unless otherwise noted.

The second product of the Mobile plant was marketed under the trade name Mobile Aid (MA). This compost is a more finely ground product than the original compost. The visible plastic content of Mobile Aid is less than the original compost; however, chemical properties were similar.

Chemical Properties of Garbage Compost

Original compost obtained in July 1966 was analyzed for some chemical properties, Table 1. Analyses were made using air dried (7% H_2O) and data reported on an oven dry (105°) basis. Water extracts showed that the compost contains appreciable cations in excess of the exchange capacity, presumably as carbonate and bicarbonate salts since the chloride and sulfate analyses were negative. X-ray spectrographic analysis of the whole compost showed the presence of lead, tin, copper, manganese, iron, and zinc. These elements were not measured quantitatively.

Table 1. Chemical Properties of Oven Dried Original Compost from the Municipal Compost Plant of the City of Mobile, Alabama

Property	Quantity
pH (1:1 water suspension)	8.4
Carbon-nitrogen ration (C/N)	38.5
Total carbon (dry combustion) per cent	34.2
Total phosphorus, per cent	0.21
Total nitrogen (Kjeldahl method) per cent	0.887
Exchange capacity (ammonium acetate method)	13.7 meq/100 g
Exchangeable bases (ammonium acetate extraction)	
Calcium	42.2 meq/100 g
Magnesium	4.3 "
Potassium	6.0 "
Sodium	15.4 "
Bases extracted with water	
Calcium	8.3 meq/100 g
Magnesium	1.1 "
Potassium	4.3 "
Sodium	15.7 "
Negative test for ammonium, nitrate, chloride and sulfate ions	

The high carbon-nitrogen ratio of 38.5 indicated that the compost was relatively immature. The compost properties could have been changed considerably by a longer composting period in the windrow, however, this would have increased the cost of composting. The low content of nitrogen combined with the immaturity of the compost indicated a demand for additional nitrogen when the compost was added to soil and underwent further decomposition. Phosphorus also appeared to be a possible limiting element for plant growth whereas calcium and potassium appeared to be in adequate supply for plant growth.

Considering the high pH and organic matter content of the compost, and the pH dependency of the exchange capacity of organic matter, it was desired to determine the buffer capacity, or resistance to change in pH when acid or base is added. Nitric acid was selected because of its high ionization and also because of its possible use in increasing the nitrogen content of the compost.

Samples of 2 g (air dry) compost were placed in 50 ml beakers and moistened with 1-12 ml of nitric acid (0.0964 N). Distilled water was added to the samples to bring the liquid volume to 12 ml. The suspensions were stirred and allowed to stand with occasional stirring for 1 hour. The pH was then determined, samples held overnight and pH determined again, and finally after 8 days standing in suspension, Table 2.

Table 2. Buffer Capacity of Garbage Compost Determined on 2 g Samples

Sample	Meq HNO_3 added	pH (after 1 hr)	pH (after 1 day)	pH (after 8 days)
1	0	8.07	7.51	7.85
2	.0964	7.11	7.89	7.93
3	.1928	6.57	8.23	8.02
4	.3856	5.96	6.97	8.02
5	.7712	4.98	6.28	7.96
6	1.1568	3.53	4.82	5.83

Increased pH upon standing 1 day, and especially at 8 days, was associated with gas bubbles formed in the compost suspensions, particularly at the higher nitric acid applications. In the most acid sample, however, mold growth predominated the compost and little gassing was apparent. It is concluded that vigorous denitrification occurred, which eliminated the nitric acid from the treated samples, except in the most acid samples where bacterial denitrification was inhibited by low pH.

The pH response to added nitric acid is shown in Fig. 1. The compost exhibits considerable buffer capacity, particularly in the pH range 5-6. On the basis of 68 meq of extractable bases and only 13.7 meq of exchange capacity it seems that about 54 meq of bases must have been present as carbonate and bicarbonate salts. The buffer curve, then, was essentially the titration of calcium and sodium carbonate and bicarbonate, with relatively little influence of the organic material. An alternative explanation might be that at pH 8.4 the exchange capacity of the compost was much greater than the 13.7 meq measured at pH 7 with ammonium acetate. The extractable bases may be held by weakly acidic exchange sites in the organic matter rather than as precipitated carbonate. The sharp drop in pH with the first increment of acid supports this latter explanation.

In summary, the compost is alkaline in reaction, containing considerable calcium, sodium, potassium, and magnesium ions. In the absence of chloride, nitrate and sulfate ions, it is likely that the basic ions are held at weakly acidic exchange sites in the organic matter and as precipitated carbonates and bicarbonates. The compost had its greatest buffer capacity at about pH 5.5. This high buffering capacity and high pH indicated that when large quantities were added to acid soils, the soil pH may be increased considerably.

Nitrogen Transformations During Decomposition of Garbage Compost in Soil

An incubation experiment was carried out to determine the effect of

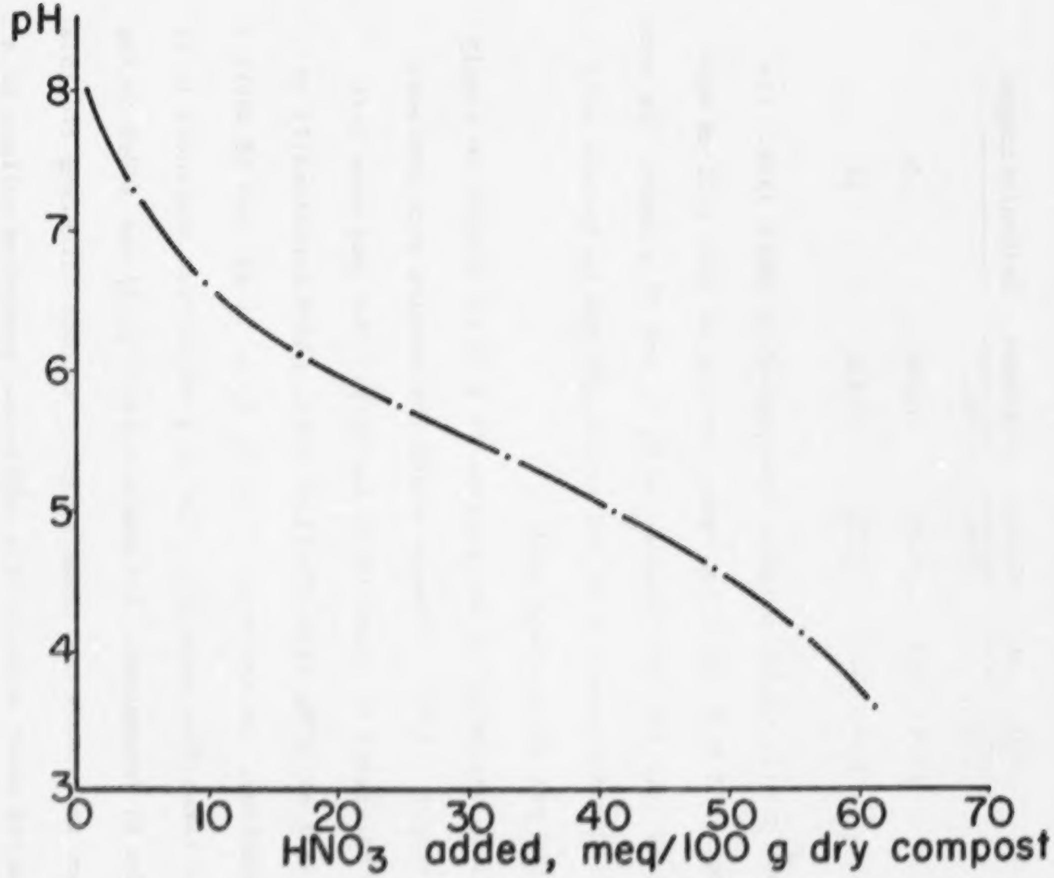

Fig. 1. Buffer capacity of garbage compost

garbage compost on immobilization and mineralization of nitrogen in soil. Both indigenous nitrogen of the compost and added fertilizer nitrogen were considered.

Two soils used were Decatur clay loam and Lakeland sand which had properties as follows: (Carbon and nitrogen values are on oven dry basis).

	H_2O	pH	Carbon	Nitrogen	Carbon/nitrogen
	Pct.		Pct.	Pct.	
Decatur c.l.	13.6	5.4	0.56	0.069	8
Lakeland s.	6.4	6.1	0.53	0.039	14

Samples of 500 g each (moist weight) were placed in quart jars. Air dry garbage compost (11% H_2O) which had been screened to pass 1.25 cm mesh was thoroughly mixed into the soil samples at 0, 5, and 25 g rates. On oven dry basis, these additions provided 10,200 and 51,200 ppm in Decatur soil and 9,600 and 48,000 ppm in Lakeland soil.

Ammonium sulfate was added to the samples in a 10 ml aliquot to supply 0 or 100 mg of nitrogen. After thorough mixing the samples were replaced into the jars and moistened to about field capacity. The jars were left open in the incubator at 30°C, with distilled water added occasionally to maintain moist condition. At intervals of 1, 2, 3, 4, 8, 12, and 18 weeks a sample of 10 g was taken from each jar. The 10 g sample was suspended in 10 ml of water and the pH determined. Potassium sulfate (1 N) was added to the suspension and then the sample was transferred to a Gooch filtering crucible. The sample was leached under suction with additional potassium sulfate to a final volume of 100 ml. The potassium sulfate extract was steam distilled to obtain ammonium nitrogen and with Devarda's alloy added to obtain nitrate nitrogen. Values for ammonium and nitrate nitrogen were corrected to ppm nitrogen on the basis of oven dry weight of soil, Table 3.

Table 3. Soil Acidity and Mineral Nitrogen Contents of 10 g Soil Samples During Incubation

Treatment		After 1 week			After 2 weeks			After 3 weeks			After 4 weeks		
Compost added ppm	N added ppm	pH	NH_4^+ ppm N	NO_3^- ppm N	pH	NH_4^+ ppm N	NO_3^- ppm N	pH	NH_4^+ ppm N	NO_3^- ppm N	pH	NH_4^+ ppm N	NO_3^- ppm N
					Decatur clay loam								
0	0	5.34	1	13	5.40	2	21	5.28	1	17	5.28	3	30
0	227	5.11	203	19	5.08	202	28	5.01	187	51	4.92	180	52
10,200	0	5.60	0	4	5.69	6	0	5.70	2	0	5.69	1	5
10,200	227	5.30	181	10	5.31	160	17	5.20	144	47	5.04	140	50
51,200	0	6.30	2	2	6.38	2	0	6.33	3	1	6.38	3	5
51,200	227	5.88	94	3	5.86	50	0	5.71	41	34	5.56	25	7
					Lakeland sand								
0	0	6.13	0	10	6.10	2	8	5.93	1	20	5.81	1	19
0	213	5.38	174	20	4.72	184	44	4.48	138	61	4.38	129	58
9,600	0	6.74	0	3	6.74	1	1	6.74	1	22	6.63	1	7
9,600	213	5.44	144	17	4.59	82	61	4.39	61	73	4.18	30	85
48,000	0	7.34	0	1	7.45	2	0	7.41	2	1	7.66	1	7
48,000	213	5.99	43	12	5.95	3	17	5.94	4	30	5.93	3	35
		After 8 weeks			After 12 weeks			After 18 weeks					
					Decatur clay loam								
0	0	5.19	1	17	5.20	1	20	5.37	1	38			
0	227	4.63	152	73	4.54	125	114	4.67	104	150			
10,200	0	5.68	2	0	5.74	6	3	5.79	1	27			
10,200	227	4.60	76	121	4.44	21	189	4.69	12	193			
51,200	0	6.39	1	2	6.42	5	5	6.46	3	54			
51,200	227	5.42	4	80	5.36	10	110	5.48	8	210			
					Lakeland sand								
0	0	5.51	3	19	5.49	2	36	5.73	2	32			
0	213	4.03	85	69	4.05	5	137	4.41	56	55			
9,600	0	6.43	1	4	6.18	9	16	6.28	1	85			
9,600	213	4.22	3	65	4.26	6	81	4.64	4	102			
48,000	0	7.49	2	0	7.56	4	6	7.61	1	47			
48,000	213	6.14	3	54	6.46	7	126	6.01	1	106			

Soil acidity was altered by incorporation of garbage compost. Since the compost itself had a pH of 8.4 the pH of the soils was increased with increasing rates of compost. In the Decatur clay loam the lower rate of compost increased the pH about 0.2 units and the higher rate about 1.0 pH units. In the Lakeland sand, with less buffer capacity, the pH increases were 0.6 and 1.3 units, respectively. Addition of nitrogen from ammonium sulfate lowered the initial pH of Decatur and Lakeland soils about 0.2 and 0.7 units, respectively, in the absence of compost. The ammonium sulfate lowered the pH of compost-treated soils 0.4 units in Decatur and 1.3 units in Lakeland.

In the absence of added ammonium sulfate there was little change in pH of the soils during incubation. Approximately 26 ppm of soil organic nitrogen was nitrified in Decatur clay loam over the 18-week period and this did not affect the soil pH. In Lakeland sand there was a drop of about 0.4 pH units with nitrification of about 25 ppm of soil organic nitrogen. Compost-treated soils, especially the Decatur, without added nitrogen were essentially stable in pH during incubation. In Lakeland with the low rate of compost there was about 75 ppm of nitrogen nitrified at the later stages of incubation and pH dropped about 0.4 units.

The 5 and 25 g additions of garbage compost amounted to 40 and 200 mg nitrogen each. Thus in Decatur samples there was 91 and 454 ppm nitrogen added in the compost at low and high rates of addition. In Lakeland soil the compost additions supplied 85 and 426 ppm nitrogen. If the mineral nitrogen increase of about 75 ppm observed in Lakeland soil at the lower compost rate is corrected for about 25 ppm of soil-derived nitrogen, the 50 ppm balance represents that released from the added compost, or about 60% in 18 weeks. Mineralization of the higher compost rate added to Lakeland soil was delayed.

In Decatur soil, no nitrogen was released from the lower rate of compost. The 30 ppm nitrogen was released from the high rate and was equivalent to 7% of the total nitrogen applied as compost. These results show that compost is very resistant to nitrogen mineralization. For 2 months or more there was no mineralization at all, and then it was erratic and slow for 2 months thereafter.

Application of ammonium sulfate to soils without compost was followed by slow nitrification and strong acidity development. The Decatur soil pH declined gradually to 4.5 at 12 weeks when about half of the applied nitrogen was oxidized to nitrate. Considerable amounts of soil manganese were reduced during this nitrification, which prevented a more drastic drop in pH. Soil pH increased in the final sampling period despite continued nitrification. At 18 weeks, the initial level of mineral nitrogen was recovered, along with an additional 26 ppm, derived from soil organic nitrogen mineralized which was in agreement with observations on Decatur soil without added nitrogen. In Lakeland soil, initial mineral nitrogen was not recovered, and large deficits were probably the result of volatilization during nitrification under the extremely acid conditions. Soil pH dropped to 4.0 at 8 weeks, with less than half of the applied nitrogen appearing as nitrate. The level of ammonium continued to decline during this acid period without corresponding increase in nitrate. This was considered to be the gaseous loss from chemically unstable nitrite.

Addition of compost resulted in nitrogen immobilization in both soils. Immobilization was maximum at 4 weeks in Decatur soil with a high rate of compost, where 195 ppm of the initial 227 ppm added was immobilized. At the lower rate of compost in Decatur, about 50 ppm nitrogen was the maximum immobilization, which occurred at 2 weeks. In the presence of ample available nitrogen it was apparent that nitrogen immobilization was proportional to the amount of compost added.

In Lakeland soil with the high rate of compost, maximum immobilization occurred at 2 weeks when 193 ppm of nitrogen became unavailable. This agrees closely with results from Decatur. Beyond the maximum immobilization stage, all samples gradually mineralized nitrogen which accumulated as nitrate. In Decatur soil the initial level of mineral N was attained by 18 weeks, with little or no loss in the process of conversion from ammonium to organic nitrogen to nitrate. In Lakeland soil, however, about one-half of the applied nitrogen was unaccounted at the 18-week sampling. It was unlikely that much remained immobilized at this stage. Apparently this deficit was volatilization loss, as observed in soil without compost. Nitrification produced strongly acid conditions in Lakeland sand with the lower rate of compost, and presumably this enhanced the volatilization. At the high rate of compost, however, the pH did not fall below about 5.8, and this should not have been acid enough for nitrite instability.

These results show the compost to be immature since a considerable period of time elapsed before the nitrogen in the compost was released. It was biologically active enough to stimulate microbial growth and to immobilize added nitrogen. About 200 parts of nitrogen were immobilized by 50,000 parts of added compost, or in the ratio of 4 parts nitrogen to 1,000 parts of compost dry matter. Recovery of immobilized nitrogen occurred after about 8 weeks, with much of it appearing as nitrate. Where acidity was not severe there was complete recovery of mineral nitrogen after 18 weeks.

These results indicated that in this original compost about 4 parts of nitrogen would be required for 1,000 parts of compost to avoid the depression of available nitrogen when compost is incorporated into the soil.

Germination of Oat, Millet, Soybean, and Vetch Seeds in Garbage Compost

Germination of 'Moregrain' oats (*Avena sativa* L.) 'Gahi-No 1' millet (*Pennisetum typhoides* (Burm.) Staph and Hubbard) 'Bragg' soybeans (*Glycine max* L.) and 'Commercial' vetch (*Vicia villosa* Roth) was determined in petri plates containing 2 g whole compost with 5 ml water. A water extract was prepared by shaking 2 g of compost in 100 ml of water for 1 hr and then leaching through No. 31 Whatman filter paper with additional water to final volume of 500 ml. Aliquots of 5 ml each were applied to folded absorbent paper in petri plates. One series of plates was sterilized by autoclaving prior to seeding, the other series was left with extract non-sterilized. Twenty-five seeds were placed in each plate. Plates were incubated at 28°C in humid cabinet.

At 1 week all treatments showed good germination and there were no differences among species. During the first week it was observed that the non-sterilized compost stimulated germination and vigor over sterilized compost and over distilled water controls. Water extract of compost did not differ with sterilization and was not different from water controls.

These results indicated that the compost did not inhibit seed germination. Apparently the deleterious effects of compost observed in field experiments on plant growth were nutritional effects incurred later, rather than injury during germination.

Response of Oats to Fertilizer and Compost in a Growth Chamber

Oats were grown on Lakeland sand in a growth chamber maintained each day at 21°C for 12 hr with light at 3,500-foot candles and a dark period of

12 hr at 16°C. Four hundred g samples of soil were placed in 236 ml milk cartons. Three rates of compost were mixed into the samples: none, 4, and 20 g per carton, corresponding to 10,000 and 50,000 ppm on the air dry weight basis (contains 7% H_2O). Nitrogen, phosphorus and potassium treatments were added to the 50,000 ppm compost cartons. These consisted of 80 mg nitrogen, 40 mg phosphorus, 70 mg potassium and combination of all three. Each sample receiving any of the fertilizer elements also received calcium sulfate to blanket out possible differences among the fertilizer sources resulting from their content of calcium or sulfate.

Oats were grown in these samples for 3 weeks after which the plants were cut at the base of the first leaf blade. The tops were oven dried at 70°C and weighed, Table 4.

Compost provided no growth stimulus to oats. Addition of nitrogen to compost-treated soil made a substantial increase in growth. Phosphorus and potassium, in the absence of added nitrogen had no stimulatory effect. These results show the compost to be rather inert in release of nutrient to growing plants, at least during a 3-week period.

After the oats were cut the first time the soil samples were treated with ammonium nitrate solution to provide 0, 100, 200, 400, and 800 ppm nitrogen in each of the 7 initial treatments, thus eliminating the replications but providing single-sample observations of the response to nitrogen in each initial treatment. The oats were cut at the soil surface after 6 weeks of growth, dried at 70°C and weighed, Table 5.

The 800 ppm nitrogen addition was injurious to the plants in all treatments. Maximum yields were obtained at the 200 and 400 ppm nitrogen rates. At the zero rate there was very little regrowth of oats except where nitrogen

Table 4. Oven Dry Weights of First Cutting of Oats Grown in a Growth Chamber

No.	Treatments	Yield in g per carton Rep I	Rep II	Rep III	Rep IV	Rep V	Av.
1.	None	.26	.29	.29	.28	.23	.27
2.	10,000 ppm compost	.25	.26	.27	.24	.24	.25
3.	50,000 ppm compost	.24	.28	.25	.25	.22	.25
4.	No. 3 + 200 ppm nitrogen . .	.35	.35	.41	.39	.45	.39
5.	No. 3 + 100 ppm phosphorus . .	.23	.24	.27	.30	.24	.26
6.	No. 3 + 175 ppm potassium . .	.26	.25	.23	.25	.19	.24
7.	Combination No. 3,4,5,6	.36	.34	.49	.48	.46	.43

Table 5. Oven-Dry Weights of Second Cutting of Oats Grown in a Growth Chamber

No.	Treatments	Yield in g per carton nitrogen added, ppm 0	100	200	400	800
1.	None	.08	.40	.44	.22	.06
2.	10,000 ppm compost	.09	.35	.59	.48	.06
3.	50,000 ppm compost	.09	.46	.54	.33	.06
4.	No. 3 + 200 ppm nitrogen . .	.58	.92	.88	.79	.12
5.	No. 3 + 100 ppm phosphorus . .	.10	.34	.96	1.20	.06
6.	No. 3 + 175 ppm potassium . .	.14	.48	.61	.77	.04
7.	Combination of No. 3,4,5,6 . .	.63	1.25	1.25	1.25	.42

had been applied in the first growing period. No nitrogen was contributed by the compost in the absence of fertilizer nitrogen. With high rates of nitrogen there was a positive interaction with residual phosphorus from the initial treatment, but not with residual potassium. This indicated that when yield limitations of nitrogen deficiency were eliminated by high nitrogen fertilization, phosphorus was the next limiting factor.

Fertility Experiments with Compost in a Greenhouse

Several proportions of original compost and Norfolk sandy loam soil were used in a greenhouse pot experiment. The soil was of extremely low fertility as a result of continuous cropping for many years without the addition of fertilizer. Millet was planted from seed in one series of pots and sod plugs of Tifton 57 bermudagrass (Cynodon dactylon (L.) Pers) 5.5 cm in diameter and 2.5 cm in height were placed in another series of pots.

Potting mixtures and fertilizer treatments are given in Table 6. The fertilizer treatments were added to each of two successive crops without changing the soil-compost mixtures in the pots. Millet was harvested just before the most advanced plants were heading. After millet was harvested the fertilizer was mixed with the potting mixture. Fertilizer was added to the surface of the potting mixture after the bermudagrass was clipped.

The compost had no effect on the germination of millet seeds.

Both the first and second crops of millet grown on compost alone reached a height of about 6 cm and did not grow further irrespective of the fertilizer treatment, Table 6. The small plants were yellow and unthrifty in appearance but did not die. The weight of plants was less than 1 g per pot.

There was some growth of the bermudagrass on compost alone in the first crop and this improved in the second crop. This growth was probably considerably influenced by the nutrients in the original sod plug.

As the proportion of soil in the mixture increased and nitrogen, phosphorus and potassium were added there was a greater growth of millet and bermudagrass in the first crop with the exception of millet on the all soil pot. Nitrogen added alone had little effect on growth, verifying the low fertility status of the soil and its requirement for phosphorus and potassium.

Table 6. Effect of Compost-Soil Mixtures and Fertilizer on the Yield of Forage Grown in a Greenhouse

Proportion by volume of		Weight in kg per pot		Fertilizer added per crop in g per pot			Yield of oven-dry forage in g per pot			
							Millet		Bermudagrass	
Soil	Compost	Soil	Compost	N	P	K	1st crop	2nd crop	1st crop	2nd crop
None	all	0	1.05	0	0	0	0	0	1	1
"	"	"	"	0.82	0	0	0	0	2	6
"	"	"	"	0.82	0.17	0.32	0	0	1	11
1/2	1/2	1.82	0.55	0	0	0	0	0	1	1
"	"	"	"	0.82	0	0	1	0	2	12
"	"	"	"	0.82	0.17	0.32	3	19	1	14
3/4	1/4	2.73	0.27	0	0	0	0	1	1	3
"	"	"	"	0.82	0	0	3	7	2	6
"	"	"	"	0.82	0.17	0.32	12	22	3	17
7/8	1/8	3.18	0.14	0	0	0	0	1	1	2
"	"	"	"	0.82	0	0	3	1	3	7
"	"	"	"	0.82	0.17	0.32	16	18	5	12
all	none	3.64	0	0	0	0	1	0	2	1
"	"	"	0	0.82	0	0	1	0	3	0
"	"	"	0	0.82	0.17	0.32	12	8	8	4

With succeeding crops the maximum yields of both crops were obtained with 1/8 or 1/4 compost by volume where complete fertilizer was applied. The lower yields in the all soil mixture were attributed to the acid condition resulting from the ammonium nitrate application to this lightly buffered soil. The mixtures containing compost were highly buffered against pH changes.

Growth of millet on the high compost mixtures increased with succeeding crops, Table 7.

Table 7. Effect of Compost-Soil Mixtures and Fertilizer on the Yield of Forage Grown in a Greenhouse

Proportion by volume of		Weight in kg per pot		Fertilizer added per crop in g per pot			Yield of oven-dry forage in g per pot			
							Millet		Bermudagrass	
Soil	Compost	Soil	Compost	N	P	K	3rd crop	4th crop	3rd crop	4th crop
None	all	0	1.05	0	0	0	0	1	4	5
"	"	0	"	0.82	0	0	2	2	8	
"	"	0	"	0.82	0.17	0.32	13	10	12	10
1/2	1/2	1.82	0.54	0	0	0	5	4	3	5
"	"	"	"	0.82	0	0	16	1	10	5
"	"	"	"	0.82	0.17	0.32	32	8	12	6
3/4	1/4	2.73	0.27	0	0	0	6	2	3	3
"	"	"	"	0.82	0	0	5	1	7	5
"	"	"	"	0.82	0.17	0.32	28	3	15	9
7/8	1/8	3.18	0.14	0	0	0	8	2	2	3
"	"	"	"	0.82	0	0	0	0	5	2
"	"	"	"	0.82	0.17	0.32	18	1	12	12
all	none	3.64	0	0	0	0	1	1	1	2
"	"	"	0	0	0	0	0	0	0	0
"	"	"	0	0.82	0.17	0.32	18	2	2	0

Yields were generally lower in the fourth than in the third crop since the most advanced plants tended to begin to head with less vegetative growth than in previous crops. The acidity and the nitrogen-phosphorus inbalance resulted in the death of all plants where nitrogen alone was added to either the all soil or the 1/8 compost pots. Bermudagrass also died where there was no compost in the pots when nitrogen alone was added.

After the all compost pots had remained in the greenhouse in a moist condition for about 1 year a fair plant could be grown where no fertilizer had been added. This indicates that the original compost was immature but with further decomposition it should be a suitable medium for plant growth. However, in the immature stage large quantities of fertilizers will be required to obtain satisfactory plant growth.

A comparison of the original compost with Mobile Aid was made to determine their respective requirements for fertilizer elements. Equal volumes of composts were compared as media for growth of millet. The original compost pots contained 1.32 kg of material and the Mobile Aid pots contained 1.82 kg of compost on an air dry basis. Five hundred ml of Hoagland's solution (5 times the normal concentration) were added to each pot each week. In addition to the complete nutrient solution, others were used in which certain essential nutrients were deleted, Table 8.

Table 8. Yield of Millet Grown on Compost Treated with Five Strength Hoagland's Solutions

Solution added at 500 ml per pot per week	Yield of oven-dry forage in g per pot	
	Original compost	Mobile Aid compost
None	0	0
Complete	19	25
Minus nitrogen	0	0
Minus potassium	7	28
Minus phosphorus	0	0
Minus calcium	5	25

Fig. 2 shows the unthrifty plants obtained where no Hoagland's solution was added. These plants reached the size expected by utilization of the elements contained in the seed. As previously observed they did not die but never exceeded 6 cm in height.

Greater amount of millet was obtained on the Mobile Aid than on original compost where a complete Hoagland's solution was added, Fig. 3. This may possibly be the result of the Mobile Aid being more refined and possibly more mature. The white mold seen on the surface of the Mobile Aid compost was not identified but apparently had no effect on plant growth. Where nitrogen was not added in the solution the other elements added had no effect on growth. The plants had the same appearance as those where no Hoagland's solution was added, Fig. 4.

The plants on Mobile Aid with the minus potassium solution added grew as well as those receiving the complete solution. However, the minus potassium solution resulted in a severe reduction in growth on the original compost.

Where phosphorus was absent in the solution, plants grew to about the height of those where no solution was added. At 28 days of age plants were living on the original compost but dead on the Mobile Aid, Fig. 5. After 40 days plants receiving no phosphorus were dead on both composts.

Leaving calcium out of the solution had no effect on the plants growing in Mobile Aid but resulted in a large reduction in growth on the original compost.

These experiments show that large quantities of both nitrogen and phosphorus were required to obtain any growth on either compost. Excellent growth was obtained with a complete Hoagland's solution on both composts, Fig. 6. With Mobile Aid the deletion of potassium and calcium had no effect on growth, Table 8. Growth of millet on original compost was reduced when any of the

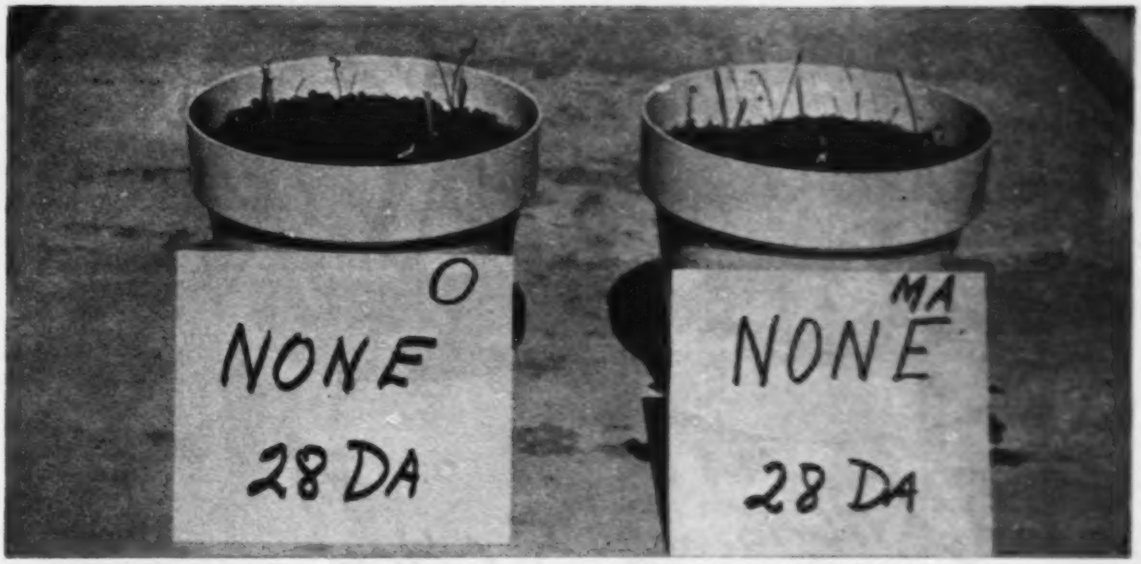
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Fig. 2. Appearance of millet on non fertilized original(L) and Mobile Aid compost(R).

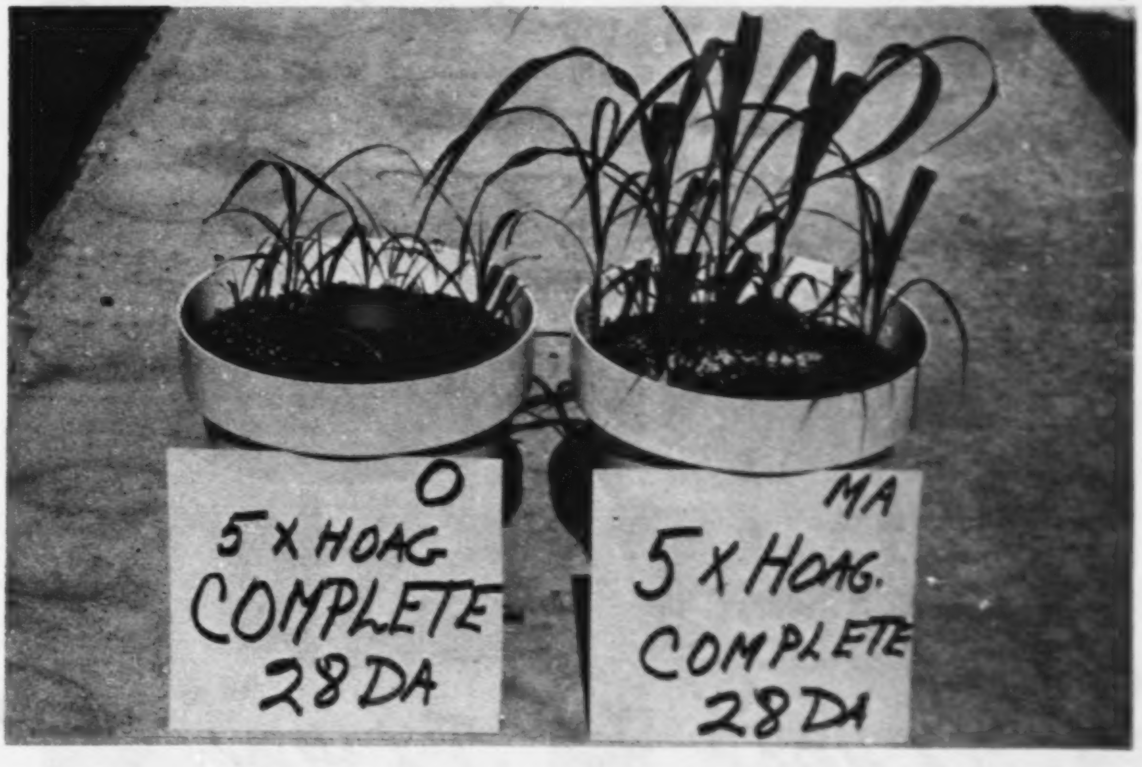
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Fig. 3. Difference in growth of millet on original(L) and Mobile Aid compost(R).

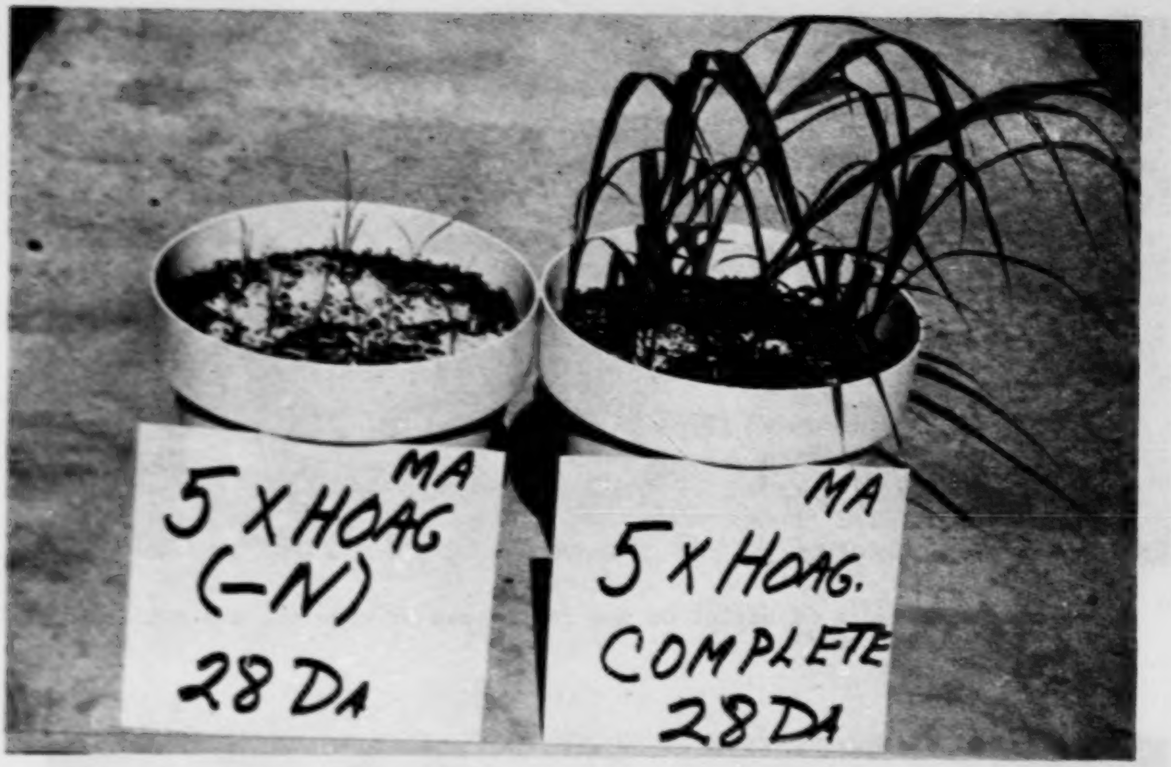
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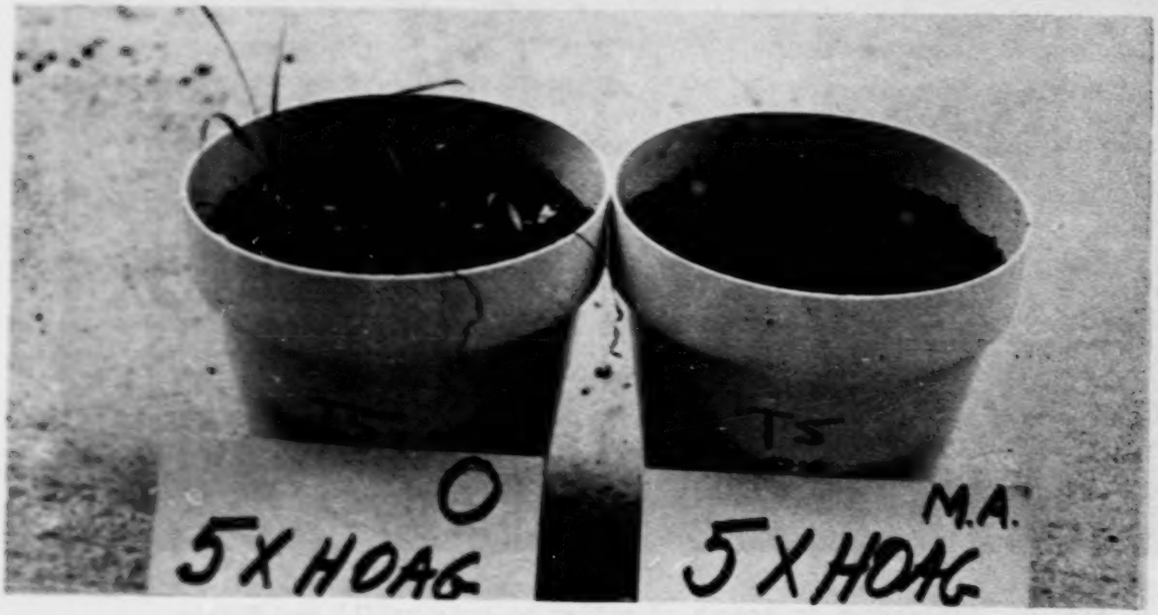
Fig. 4. Effect of nitrogen on growth of millet in Mobile Aid Compost.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O
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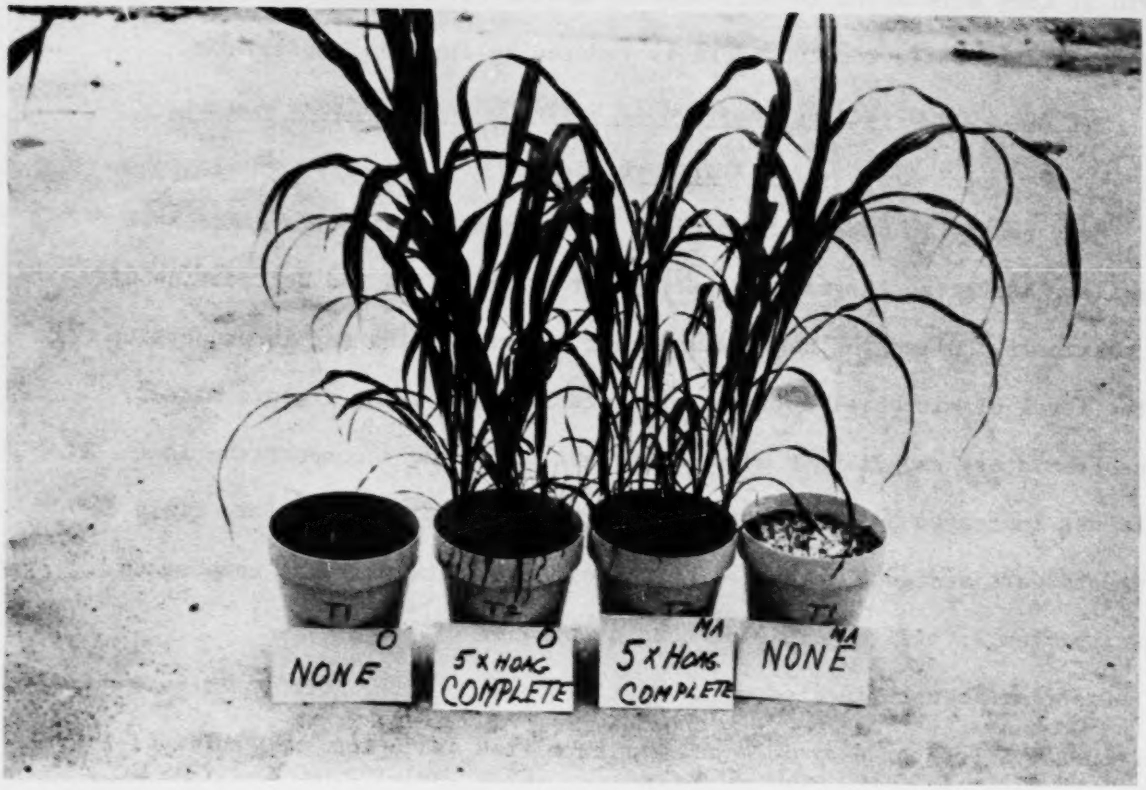
Fig. 5. Millet dead or dying where no phosphorus was applied to original (L) and to Mobile Aid (R) compost.


O
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O
5 x HOAG
COMPLETE
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5 x HOAG.
COMPLETE
MA
NONE

Fig. 6. Millet growth on original (L) and Mobile Aid (R) compost with and without fertilizer.

following elements were removed from solution: nitrogen, potassium, phosphorus, and calcium. This indicates that although the total nutrient contents of both composts were similar evidently the Mobile Aid was more mature than the original compost. Both composts probably would be satisfactory for plant growth if they were added to soil several months before seeding or if the carbon-nitrogen ratio was considerably reduced by further composting.

Garbage Compost for Reclamation of Soils Containing Toxic Amounts of Herbicides

Many synthetic organic herbicides are persistent in soils since soil microflora lacks the enzymatic capacity for assimilation and degradation of the chemicals. Often the degradation that occurs is slow and in proportion to the level of microbial activity utilized in decomposing organic matter. Since laboratory experiments have shown that herbicide decomposition in soils was increased by the addition of decomposable plant material, field experiments were designed to determine the effect of the original compost on toxicity from excessive herbicide concentrations.

Experiments were located on Chesterfield sandy loam, Norfolk loamy sand, Houston clay, Decatur clay loam and Marlboro fine sandy loam. Herbicides applied were bromacil (5-bromo-3-sec-butyl-6-methyluracil), picloram (4-amino-3, 5,6-trichloropicolinic acid), fluometuron (1,1-dimethyl-3-(a,a,a,-trifluoro-m-tolyl)urea), trifluralin (a,a,a,-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), and simazine (2-chloro-4,6-bis(ethylamino)-S-triazine). Rates of active material applied were 50 lb per acre of bromacil and 30 lb per acre of all other herbicides. These rates were 10 times or more than recommended rates for use in weed control and were applied to establish initial toxic conditions in the soil. There was a compost amendment and a non-amended treatment on each area treated with herbicides. Compost containing 20% water was spread 3 inches deep over the soil surface. This was approximately 224 tons (metric)/ha or 100 tons (English)/A. Compost was disked into the soil. Fertilizer was applied uniformly over the experimental areas as needed.

'Abruzzi' rye (Secale cereale L.), 'Ga. 1123', oats, wheat (Triticum aestivum L.), 'Gulf' ryegrass (Lolium multiflorum Lam.), Caley peas (Lathyurs hirsutus L.), 'Ky. 31' tall fescue (Festuca arundinacea Schreb), vetch, 'Autauga' crimson clover (Trifolium incarnatum L.) and 'Ladino' clover (Trifolium repens L.) were planted in rows across all plots in September and October. Visual estimates of herbicide injury were made at intervals during the growing period. Ratings ranged from 0 (no injury) to 100 (complete kill).

The soil was turned in the following spring and prepared for planting summer crops. One row each of cotton (Gossypium hirsutum L.), corn (Zea mays L.), 'Early runner' peanuts (Arachis hypogaea L.) and soybeans was planted on each plot. Herbicide injury was rated at intervals thereafter by the same scale, 0 to 100. Crop growth was measured by green weight yields of cotton, corn, and soybeans cut at the ground level and peanut plants pulled with roots and nuts. After harvest, the soil was turned and prepared for planting the fall crops. Fall crops planted were those of the previous year with exception of caley peas, which was deleted after the first crop. Injury ratings were made on these crops, then green weight yields were obtained by mowing in the spring.

Cotton, corn, peanuts, and soybeans were replanted the second year. Injury ratings were made during the summer and yields were measured in the fall. Green weight of above-ground portions of cotton and peanuts were obtained from the experiment on Marlboro soil along with grain yield of corn and bean yield of soybeans. Yields of seed cotton, grain corn, threshed soybeans, and green weight of peanut vines were obtained from the test on

Decatur soil. Similar data were obtained on Norfolk soil except that soybeans were not included. On the Houston soil grain corn yields and green weight yields of the other crops were measured. Yields of grain corn, seed cotton and threshed soybean were obtained from the experiment on Chesterfield soil. After removal of the summer crops the soil was turned and prepared for the third fall seeding using the species previously planted.

Influence of the compost on herbicide toxicity was apparent early in the experiments. Toxicity of fluometuron and trifluralin was reduced in the presence of the compost. Results from the Norfolk soil showed this amelioration in the first crops grown after treatments were established, Table 9. Observations at the other locations indicated a general reduction in toxicity as a result of the application of compost on areas treated with these two herbicides. Toxicity from simazine, picloram, and bromacil was not affected by compost.

Crop growth on Decatur clay loam where picloram was added was limited to grasses, since all broadleaf plants were killed. Corn and the winter grasses, rye, wheat, oats, fescue, and ryegrass persisted in much reduced stand but produced little yield. Compost did not affect picloram toxicity and the toxic condition diminished slowly.

Bromacil was essentially a soil sterilant, leaving neither grasses nor broadleaf plants on Decatur soil.

Yields with the fluometuron, trifluralin, and simazine treatments are given in Table 10. Data for the first summer crop are green weights per 30 ft of row. Data for rye, wheat, and oats yields are sums of the 3 species. In the second year, crop growth on many of the plots was already returning to normal and yields were measured of harvestable crops, except in the case

Table 9. Herbicide Injury Ratings on the First Fall Crops after Applying Compost on Norfolk Sandy Loam[1]

Treatment	Rep I		Rep II		Rep III		Av.	
	Grasses	Legumes	Grasses	Legumes	Grasses	Legumes	Grasses	Legumes
Bromacil	100	100	100	100	100	98	100	99
Bromacil + compost	95	70	100	85	98	95	98	83
Picloram	40	100	0	100	0	100	13	100
Picloram + compost	0	100	0	100	0	100	0	100
Fluometuron	98	85	100	30	100	90	99	68
Fluometuron + compost . . .	40	80	75	50	40	95	52	75
Simazine	85	70	90	30	100	95	92	65
Simazine + compost	85	70	95	55	95	80	92	68
Trifluralin	98	95	100	100	100	100	99	98
Trifluralin + compost . . .	80	75	80	80	75	65	78	73
No herbicide	0	0	0	0	0	0	0	0
No herbicide + compost . . .	0	0	0	0	0	0	0	0

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[1] Rating of 0 = no injury, 100 = complete kill of plants.

Table 10. Crop Growth on Decatur Clay Loam Treated with Herbicides and Compost

Herbicide treatment	First summer crop green weight				First winter crop green weight	Second summer crop			
	Cotton	Corn	Peanuts	Soybeans	Small grain	Seed cotton	Shelled corn	Green peanuts	Threshed soybeans
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Fluometuron	37.6	0.4	0	0	0.9	3.67	3.92	1.75	0
Fluometuron + compost . .	36.8	4.1	0.2	0	5.0	5.50	10.33	16.17	2.27
Trifluralin	0	0	5.9	0.1	0.7	1.25	1.58	12.50	3.42
Trifluralin + compost .	71.3	6.0	18.2	12.7	5.1	4.58	8.25	32.75	7.08
Simazine	18.5	13.8	0	6.9	5.6	4.17	7.17	23.17	5.45
Simazine + compost . .	5.1	15.4	1.6	0	6.9	4.25	10.67	20.67	6.17
No herbicide	50.6	19.8	16.3	27.8	2.1	3.58	11.92	24.50	5.85
No herbicide + compost .	35.2	21.4	4.4	7.5	6.0	4.08	11.50	23.83	6.87

of peanuts where entire plants were harvested.

Trends in toxicity with time, comparing herbicide alone with herbicide plus compost, are shown for simazine, fluometuron, and trifluralin, Figs. 7, 8, 9). Points for the first summer crops are average ratings of cotton, corn, peanuts, and soybeans. The November data points are average ratings of vetch, ryegrass, oats, wheat, and rye. The March ratings for these crops included fescue, crimson clover, and ladino clover as well as the above winter crops. Plants for ratings in June the second year were averages of the four summer crops.

Simazine was toxic to cotton, peanuts, and soybeans, Fig. 7. Occasional plants escaped and survived to make some growth, but this did not seem to follow any pattern. Corn growth was reduced slightly by this rate of simazine. Compost additions had little if any effect on simazine injury.

Rye, wheat, and oats, grew as well on simazine plots as on the check plots with no difference because of compost. Apparently simazine was lost from the soil at a rapid rate regardless of compost treatment.

Fluometuron completely eliminated peanuts and soybeans in the first year, 9 months after herbicide application, Fig. 8. Cotton and corn were more tolerant of fluometuron; however, little survived as the season progressed. The addition of compost resulted in some growth of corn and much improved cotton on fluometuron plots. Ratings of injury to crops following in the fall showed the ameliorating influence of compost. Oats, wheat, and rye were especially sensitive to fluometuron in the absence of compost, but showed no injury in the presence of compost. Similar ratings of these crops in the spring showed advanced injury to all species with fluometuron alone and little if any injury with compost. Fluometuron residues had apparently diminished by the second year since peanuts and soybeans survived and made some growth

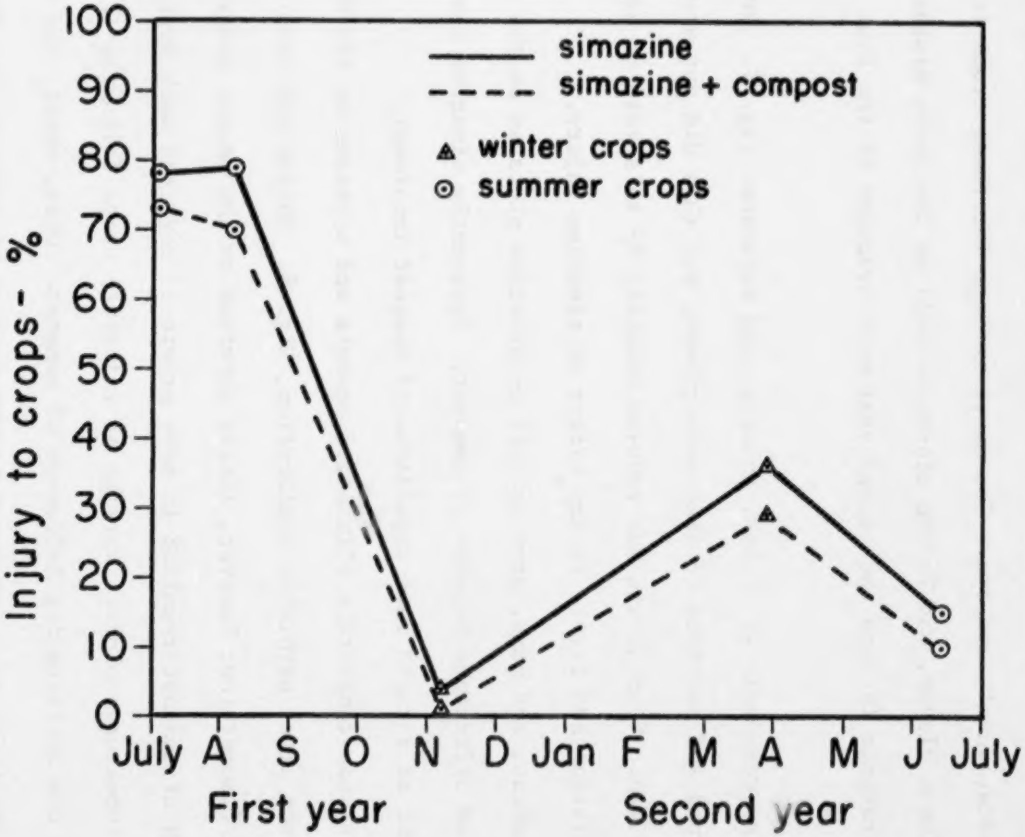

Fig. 7. Injury from simazine to crops on Decatur clay loam

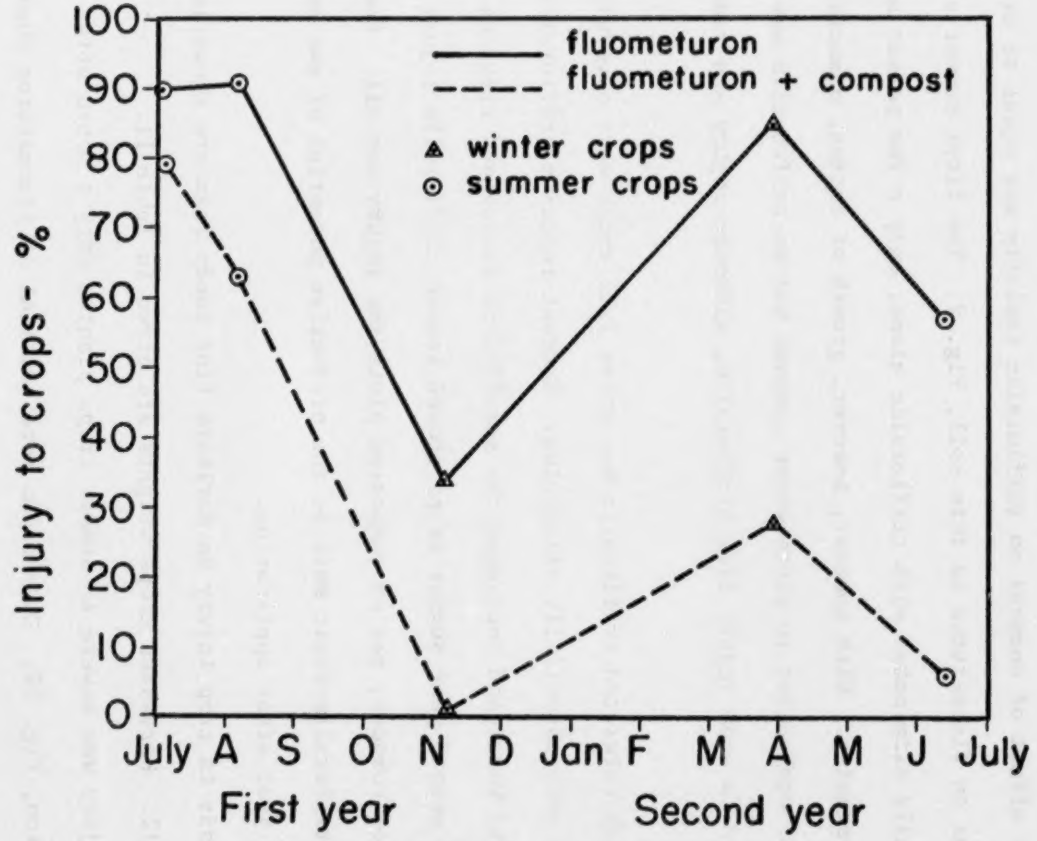

Fig. 8. Injury from fluometuron to crops on Decatur clay loam

even in the absence of compost. However, in presence of compost these crops made considerable growth with only slight injury. Cotton and corn were moderately injured with fluometuron alone but with compost these crops were equal to or better than the control.

These results show that compost facilitated the return of Decatur soil to normal production of cotton, corn, and small grains within 2 years after application of 30 lb per acre of fluometuron. Without compost, appreciable injury persisted especially to peanuts and soybeans.

The effect of compost on trifluralin toxicity was equal to or greater than that on fluometuron in this soil, Fig. 9. The first summer crops were essentially eliminated with trifluralin alone, only a few peanut and soybean plants escaping. With compost, however, growth of cotton, peanuts, and soybeans was equivalent to plots where compost but no trifluralin was added. Corn continued to show injury from trifluralin, although injury was reduced by compost.

Vetch tolerated trifluralin but other fall crops were severely injured and oats were essentially eliminated. Compost rendered trifluralin non toxic to rye and wheat and increased the survival of fescue and ryegrass.

All second year summer crops showed severe trifluralin injury in the absence of compost, yet on composted plots the injury was nil. Compost restored trifluralin-toxic soil to the productive potential of the controls within 1 year after application.

Trends in crop injury on Marlboro fine sandy loam are shown in Figs. 10, 11, and 12. Harvested crops weights are given in Table 11.

Injury was severe in summer crops planted only a month after fluometuron application, Fig. 10. Cotton was more tolerant of fluometuron than were the

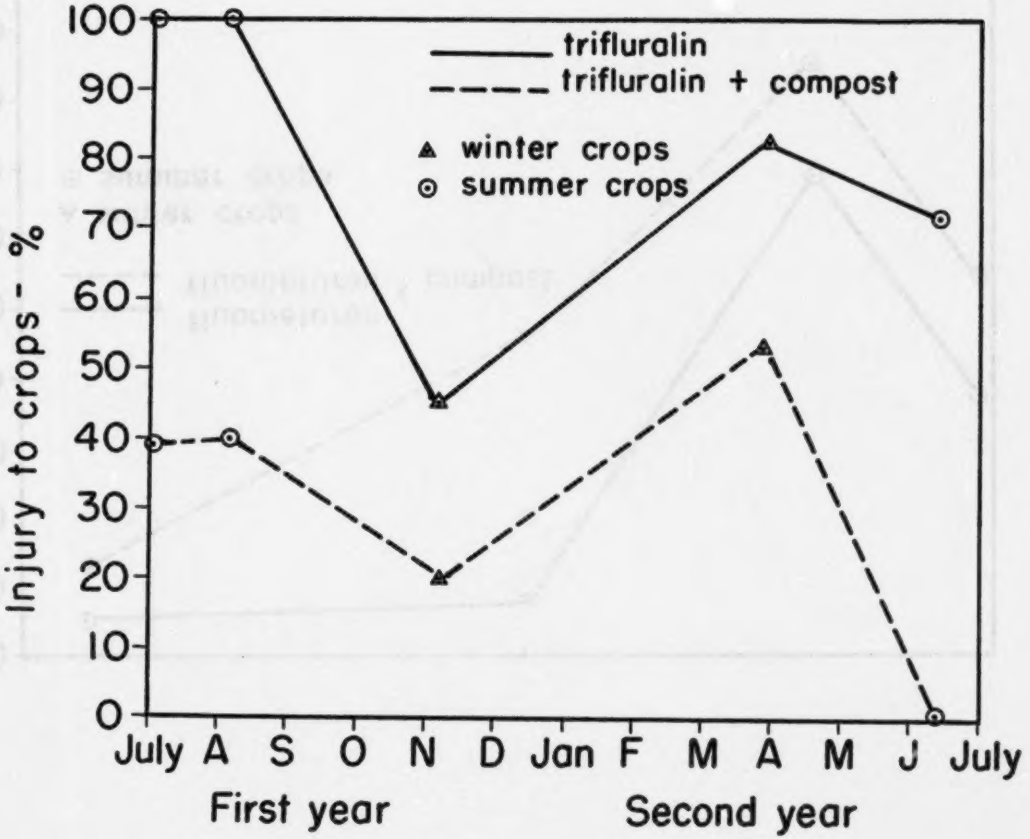

Fig. 9. Injury from trifluralin to crops on Decatur clay loam

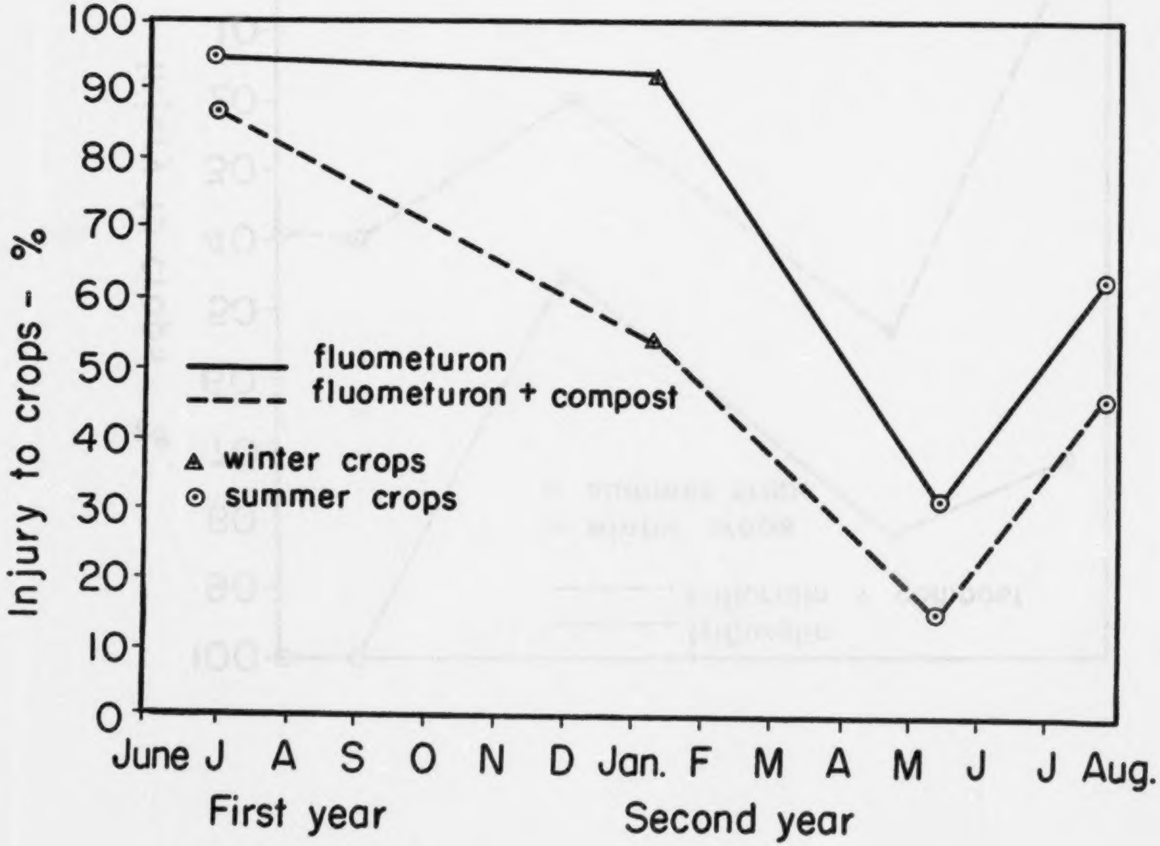

Fig. 10. Injury from fluometuron to crops on Marlboro fine sandy loam

Table 11. Crop Growth on Marlboro Fine Sandy Loam Treated with Herbicides and Compost.

Herbicide treatment	First summer crop Green weight Cotton	 Corn	 Peanuts	 Soybeans	First winter crop Green weight Small grain	Second summer crop Green wt. cotton	 Shelled corn	 Green peanuts	 Seed soybeans
	lb	lb	lb	lb	lb	lb	lb	lb	lb
Fluometuron	48.7	0	0	3.6	1.5	98.0	5.4	1.0	2.2
Fluometuron + compost .	110.0	0.1	0	0	6.0	89.0	14.3	1.6	0.6
Trifluralin	16.1	0	1.4	7.1	0	62.0	2.5	17.6	4.4
Trifluralin + compost .	63.1	0	3.3	2.1	1.5	102.0	1.7	25.2	4.1
Simazine	0	29.8	0	0	17.8	48.7	15.9	18.4	4.9
Simazine + compost . .	0	19.4	0	0	11.5	47.7	15.9	1.6	9.8
Check	81.4	37.4	18.4	11.3	17.6	23.8	12.8	18.5	5.2
Check + compost . . .	84.3	42.5	17.1	18.7	26.6	59.3	16.9	15.2	3.6

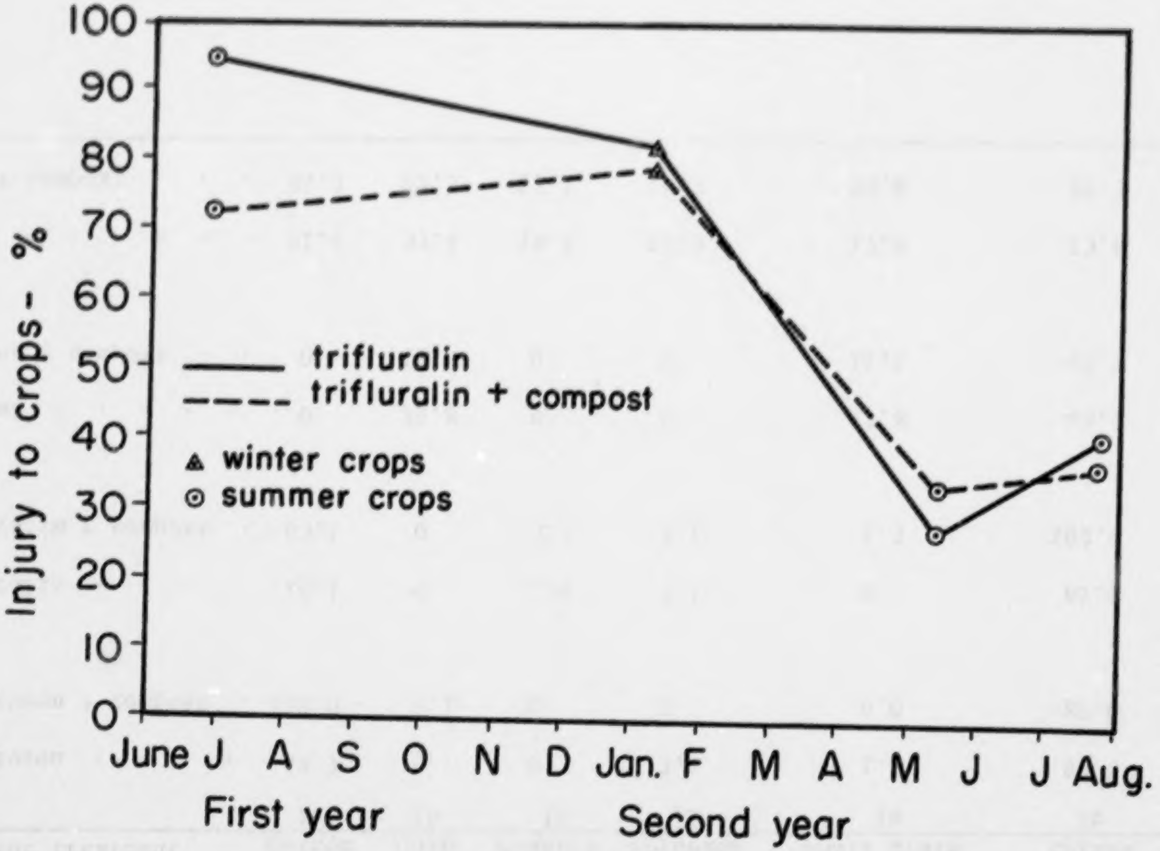

Fig. 11. Injury from trifluralin to crops on Marlboro fine sandy loam

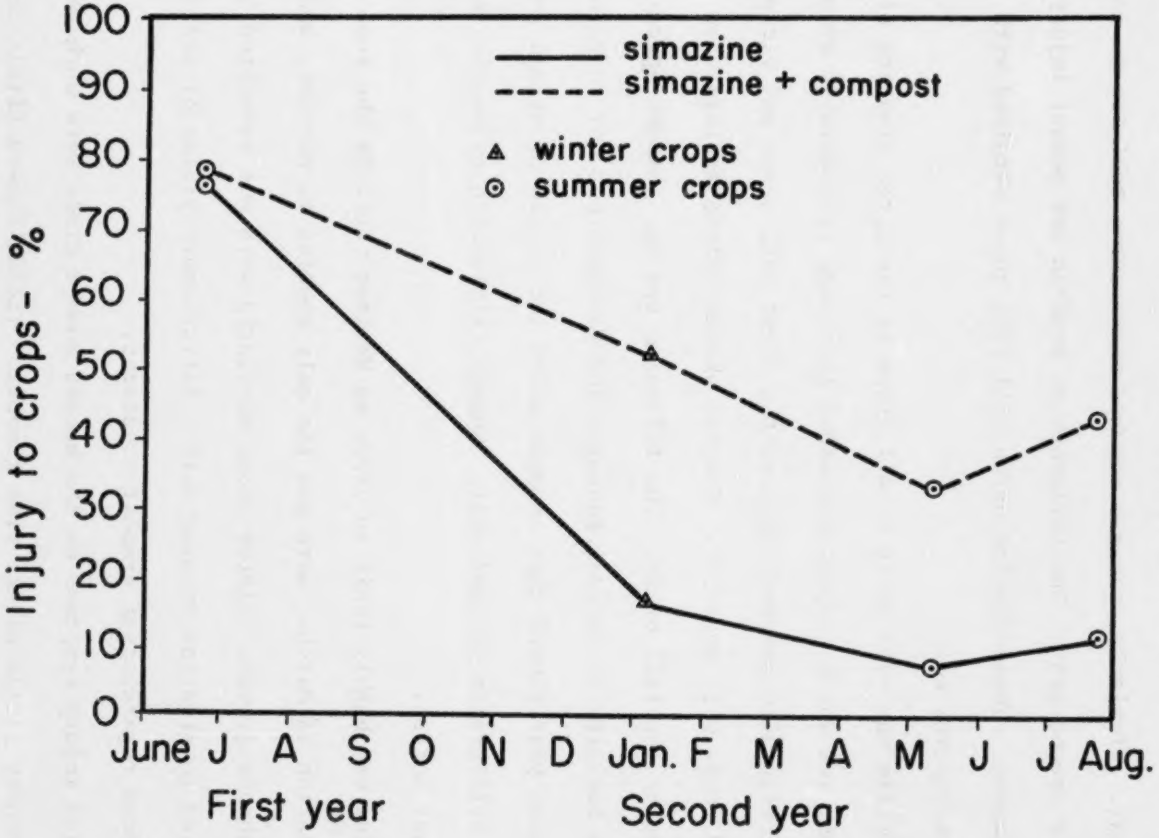

Fig. 12. Injury from simazine to crops on Marlboro fine sandy loam

other crops. Compost improved the growth of cotton on fluometuron plots to equal that on control plots in the first growing season.

Compost markedly improved the survival of ladino and crimson clover, vetch, rye, wheat, and ryegrass in fluometuron treated soil. Yields of winter crops showed herbicide injury, yet there was considerable amelioration with compost. Similarly, compost reduced fluometuron toxicity to cotton and corn in the second year. The influence on soybean and peanut injury was slight, however. These results agree well with those obtained with fluometuron on Decatur soil.

Trifluralin was very toxic to all crops in the first planting after application, yet where compost was added there was considerable growth of cotton. Trifluralin severely injured the first fall crops and yields of the second crops were very low. Compost showed little influence on trifluralin injury to the fall crops. The following spring, compost appeared to reduce the toxicity to cotton, peanuts, and soybeans but not to corn. Yields in the second year showed that compost aided the return of normal growth of cotton on trifluralin-treated soil. Enough trifluralin persisted to injure corn but not cotton.

Simazine was highly toxic to crops on Marlboro soil in the summer after its application in March. Corn was the only species to survive, and compost did not enhance growth. Winter crops similarly were not benefited by compost applied to simazine treated soil. Satisfactory yields of small grains were obtained regardless of compost treatment.

Simazine injury symptoms on the second summer crops were much reduced, with apparently little effect from compost. Yields showed little residual toxicity effects of simazine less than 2 years after application.

Results of injury on Norfolk loamy sand are graphed in Fig. 13, 14, and 15 with crop yields given in Table 12.

Some contamination of herbicide treatments across plots was apparent in the first fall seeded crops as the result of lateral movement of surface water. Subsequent cropping indicated the contamination decreased with time and was probably superficial.

The compost effects of fluometuron and trifluralin observed on Decatur and Marlboro soils were not observed on Norfolk soil. Injury ratings with these herbicides and simazine on Norfolk soil showed decreasing toxicity with time, but no consistent differences because of compost. Yields of winter crops and cotton and corn in the second year indicated that simazine was gone from the soil less than 2 years after application. Fluometuron had disappeared as indicated by cotton and corn. Enough trifluralin persisted to injure corn but not cotton.

Injury ratings on Houston clay are shown in Figs. 16, 17,and 18 with harvested plant weights given in Table 13.

Fluometuron responded to compost addition in much the same manner as on Decatur and Marlboro soils. Ratings the first year indicated a high toxicity in all fluometuron plots. Oats and ryegrass grown where fluometuron was applied appeared to benefit from compost additions.

Compost appeared to alleviate the toxicity of trifluralin to some extent, but results were not consistent. Yields in the second season showed that compost eliminated the toxicity of trifluralin to cotton, corn, and soybeans, Table 13. Similarly, compost on simazine plots produced crop growth similar to the controls.

Table 14 presents the crop yields on Chesterfield sandy loam. Ratings

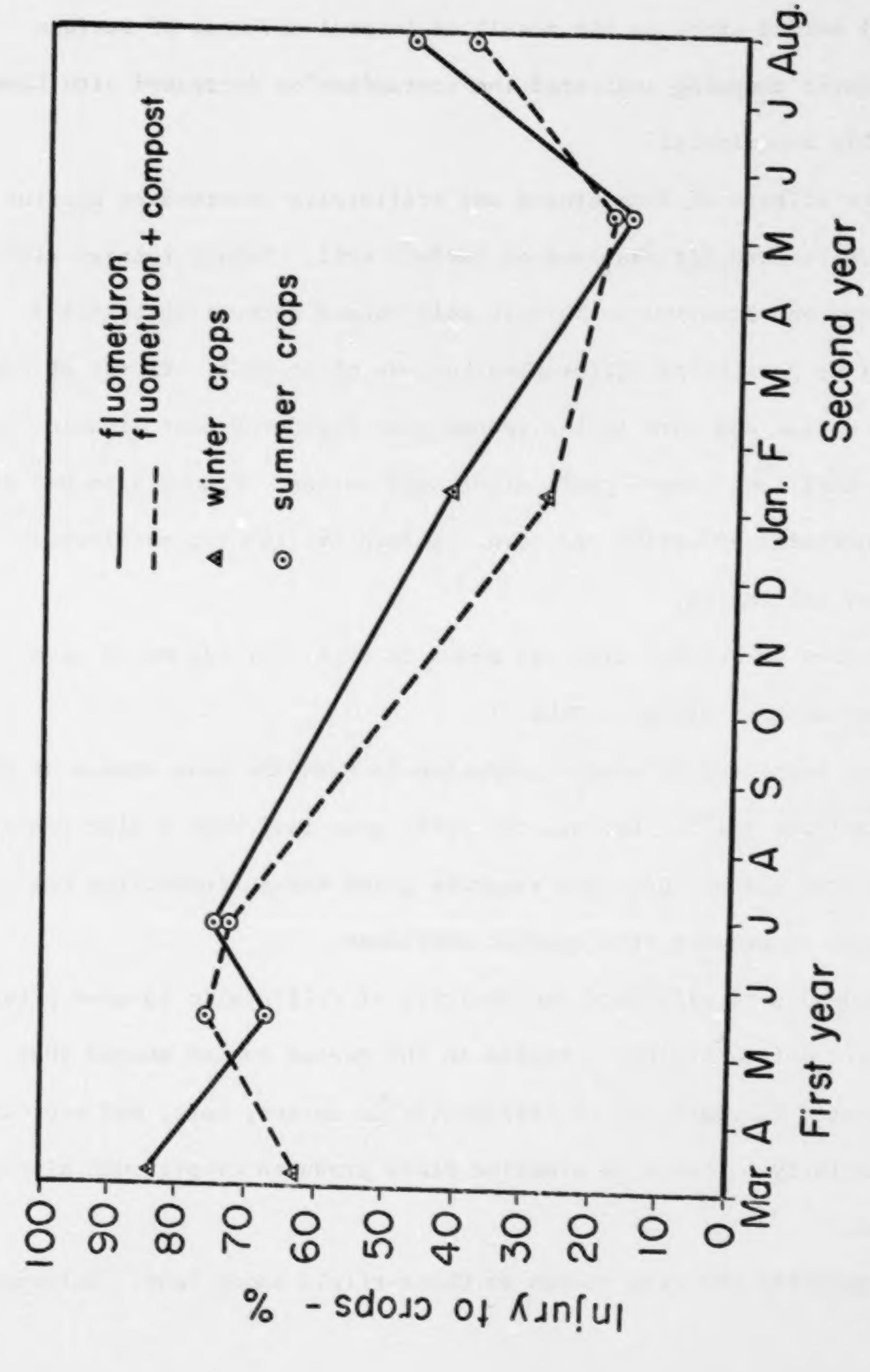

Fig. 13. Injury from fluometuron to crops on Norfolk sandy loam

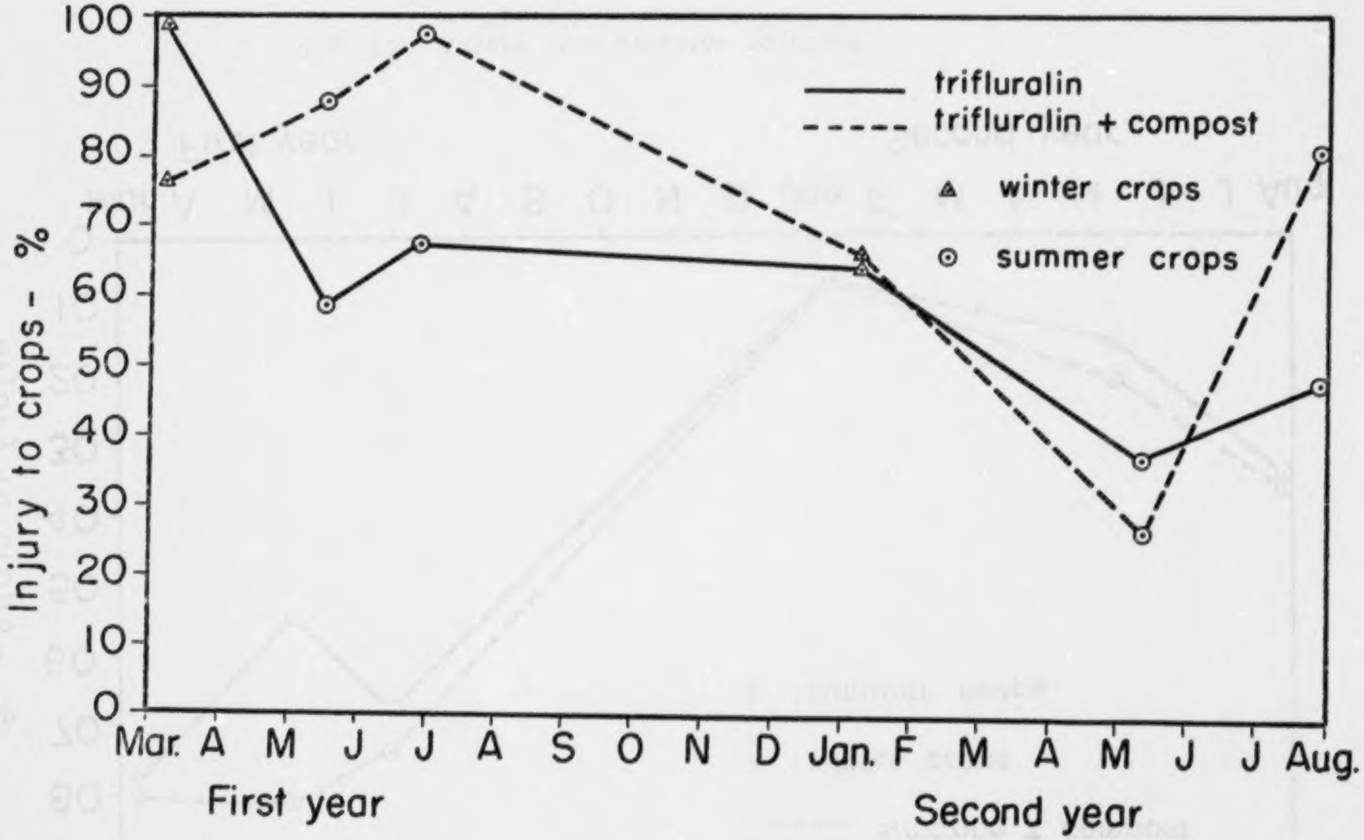

Fig. 14. Injury from trifluralin to crops on Norfolk sandy loam

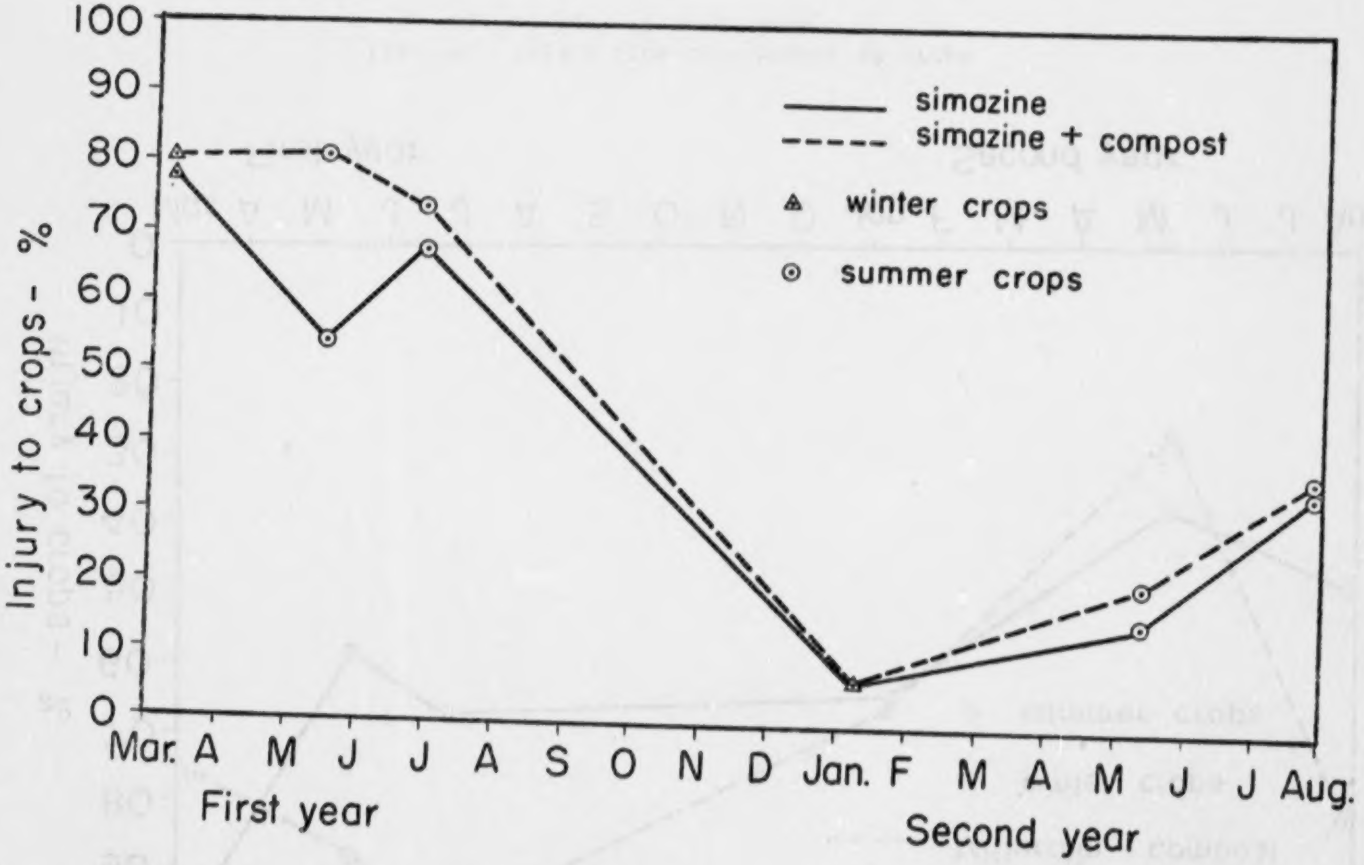

Fig. 15. Injury from simazine to crops on Norfolk loamy sand

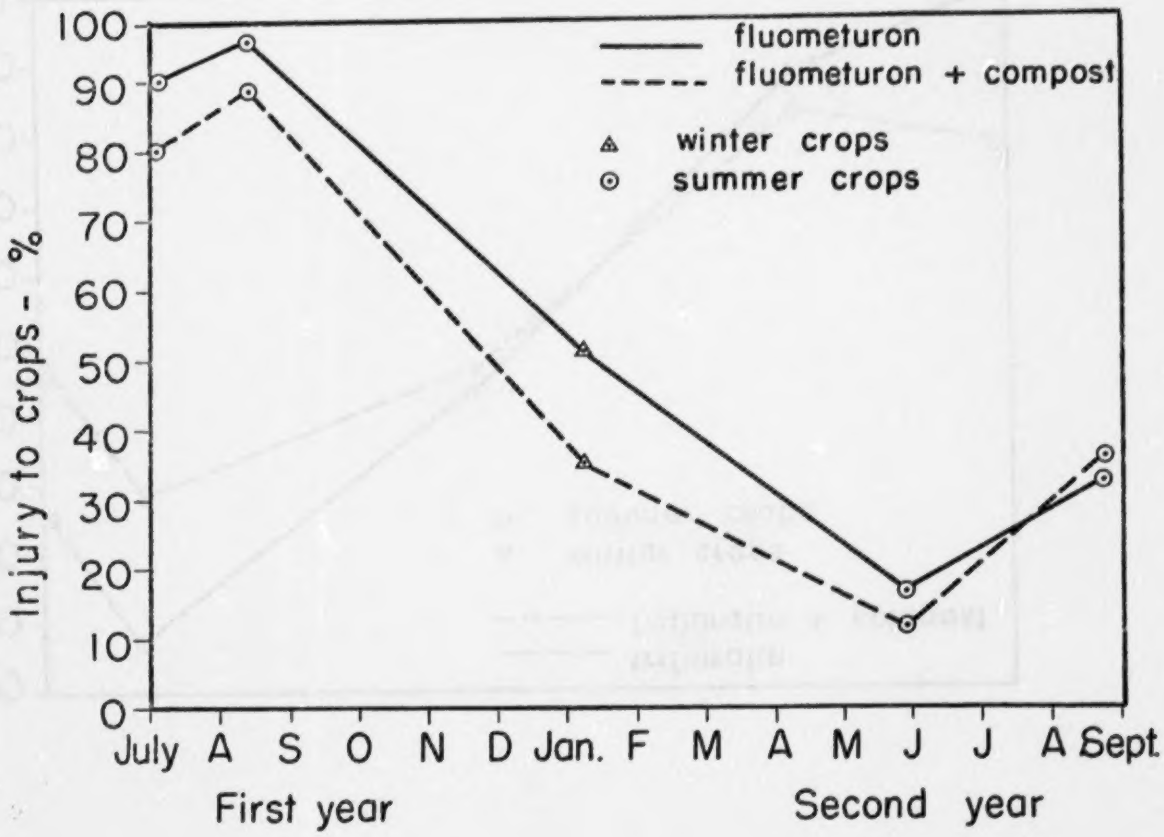

Fig. 16. Injury from fluometuron to crops on Houston clay

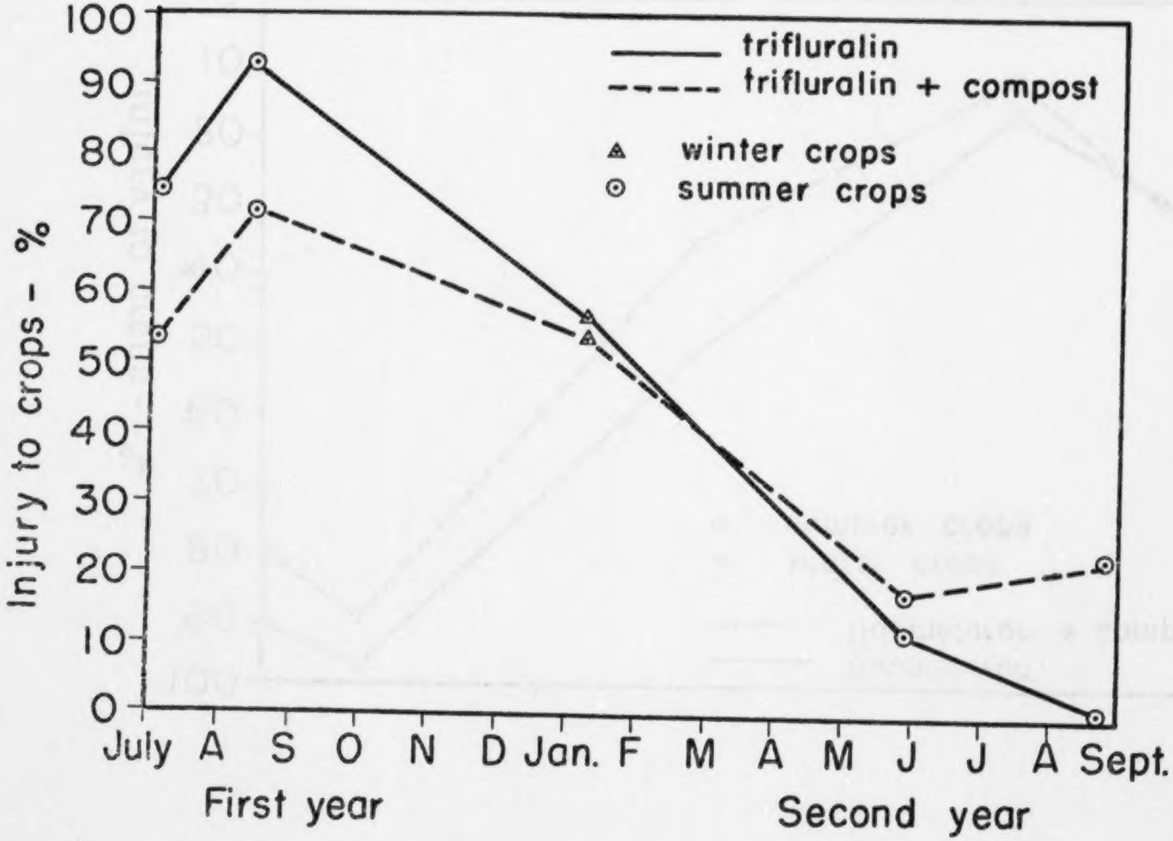

Fig. 17. Injury from trifluralin to crops on Houston clay

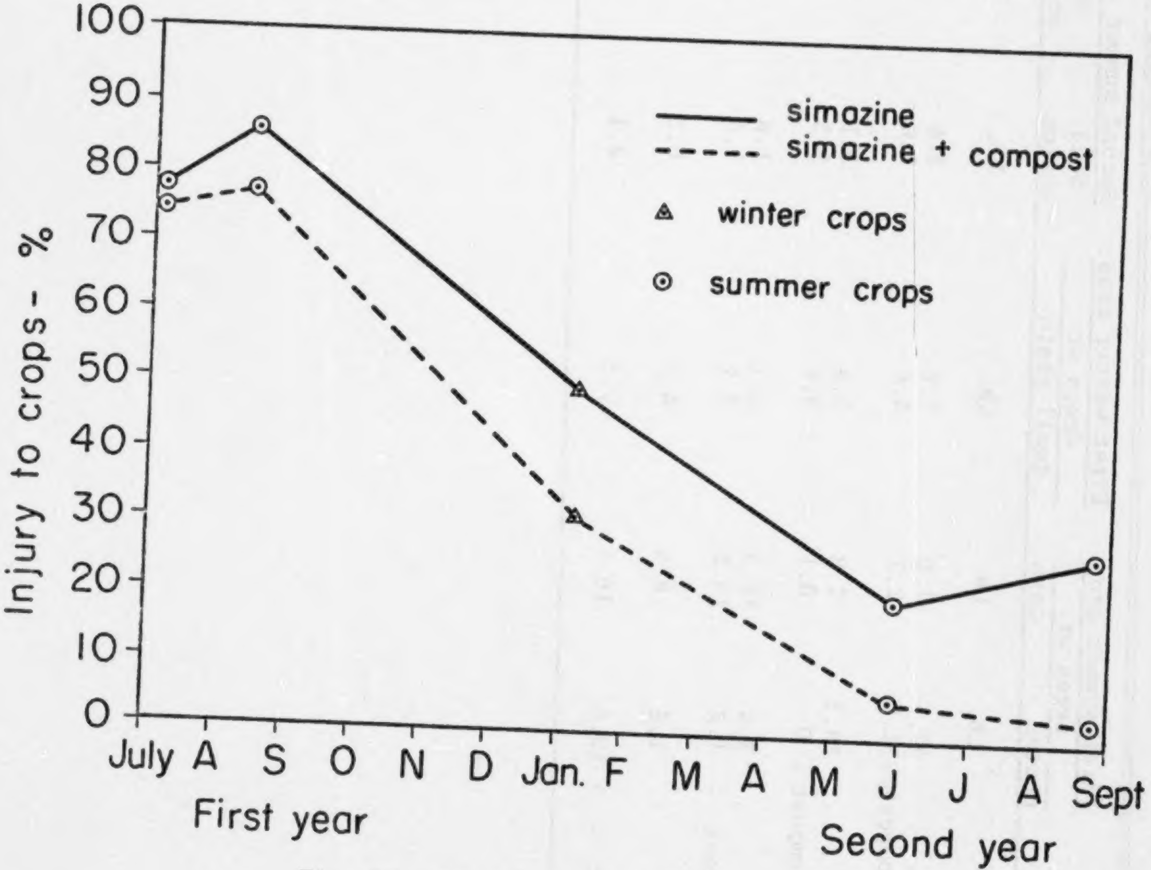

Fig. 18. Injury from simazine to crops on Houston clay

Table 12. Crop Growth on Norfolk Loamy Sand Treated with Herbicides and Compost.

	First summer crop		First winter crop	Second summer crop	
	Green wt.		Green wt.		
	Cotton	Corn	Small grain	Seed cotton	Ear corn
	Lb.	Lb.	Lb.	Lb.	Lb.
Fluometuron	47.7	1.0	5.1	3.4	3.4
Fluometuron + compost	31.0	2.7	4.6	3.0	3.6
Trifluralin	28.5	1.8	5.4	3.1	0.2
Trifluralin + compost	0	0.1	3.4	3.3	0.3
Simazine	3.4	14.3	6.1	1.8	3.4
Simazine + compost	1.7	19.2	7.1	1.4	1.8
Check	1.2	8.4	4.2	0.3	1.4
Check + compost	13.6	16.4	7.5	2.1	3.0

Table 13. Crop Growth on Houston Clay Treated with Herbicides and Compost

	First summer crop		Second summer crop			
	Green cotton	Green corn	Green cotton	Ear corn	Green peanuts	Green soybeans
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Fluometuron	13.4	0.4	47.0	8.9	0	5.6
Fluometuron + compost . .	16.6	1.6	56.6	8.3	0.7	4.5
Trifluralin	12.5	2.8	41.9	9.3	9.9	10.4
Trifluralin + compost . .	12.4	14.6	61.3	12.7	7.2	12.2
Simazine	0.2	4.3	44.4	10.7	0.9	8.6
Simazine + compost . . .	0	12.9	61.4	12.4	4.4	9.1
Check	12.2	14.2	35.2	7.7	3.1	6.6
Check + compost	6.1	5.1	65.7	11.4	8.0	9.4

Table 14. Crop Growth on Chesterfield Sandy Loam Treated with Herbicides and Compost

Herbicide treatment	First summer crop				First winter crop	Second summer crop		
	Green weight				Green weight			
	Cotton	Corn	Peanuts	Soybeans	Small grain	Seed cotton	Ear corn	Seed soybeans
	Lb	Lb	Lb	Lb	Lb	Lb	Lb	Lb
Fluometuron	4.9	31.2	7.7	0	1.9	1.8	3.8	1.2
Fluometuron + compost .	36.4	22.5	0.4	0.1	6.5	3.7	7.7	1.4
Trifluralin . . .	30.3	2.2	4.1	0	6.1	2.3	8.2	4.7
Trifluralin + compost .	18.0	1.0	9.4	0.3	6.9	3.0	4.2	4.3
Simazine	1.6	19.2	0.6	0	13.0	1.8	10.2	3.2
Simazine + compost . .	0.3	37.7	0	0.2	12.2	2.0	15.3	3.3
Check	20.4	8.6	5.8	0	11.5	1.8	8.9	1.9
Check + compost . .	45.4	44.8	10.4	0	13.6	2.5	10.9	5.4

made the first year showed that fluometuron injury to cotton was reduced by addition of compost. Among the winter crops, oats yield was most increased by compost. Cotton yield in the second year showed that compost additions ameliorated the fluometuron treatment to where yields were similar to the controls.

Trifluralin effects appeared to be moderated in the first year by compost as indicated in the August ratings, yet yields that year did not verify this. Results with winter crops and the second summer crops showed that trifluralin toxicity was rapidly diminishing regardless of compost treatment. Similar results were obtained with simazine.

To determine the depth of penetration of herbicides into the soil, experiments on Norfolk and Decatur soils were sampled approximately 8 months after applications of herbicides and compost. A bucket auger was used, taking soil from 0-6", 6-12", and 12-18" depth at 2 positions in each plot. The 12-18" depth was omitted on the Decatur soil. Soil samples were air dried, screened to pass a 1/4" mesh, and weighed into milk cartons using 350 g of soil. Cotton, soybeans, and oats were planted and grown in the greenhouse for 4 weeks. The above ground portions were cut and dry weight determined. Treatment means are given in Tables 15 and 16.

Bromacil was most toxic to oats and least to soybeans. All depths in both soils contained lethal amounts of bromacil for oats. Growth of cotton indicated bromacil moved below the 0-6" depth to such an extent that the greatest residue occurred in the 12-18" depth. Soybean yields were reduced to about one-half of the controls in all depths. Compost had no effect on bromacil toxicity.

Soybeans were more sensitive to picloram than were oats. None of the broadleaf species survived at either depth in the Decatur soil whereas there

Table 15. Yield of Plants Grown on Decatur Clay Loam Soil 8 Months after Herbicide Treatment.

Herbicide treatment	Yield of oven dry plants per carton					
	Soil from 0-6" depth			Soil from 6-12" depth		
	Cotton	Soybeans	Oats	Cotton	Soybeans	Oats
	g	g	g	g	g	g
Bromacil	.11	.26	.08	.02	.32	.08
Bromacil + compost .	.07	.16	.06	.10	.18	.08
Picloram	0	0	.23	0	0	.19
Picloram + compost .	0	0	.23	0	0	.13
Fluometuron . . .	.23	.18	.13	.43	.41	.13
Fluometuron + compost	.30	.36	.10	.23	.23	.10
Simazine	.13	.41	.14	.17	.41	.14
Simazine + compost .	.22	.27	.14	.32	.25	.10
Trifluralin	.21	.34	.07	.23	.42	.19
Trifluralin + compost	.28	.58	.18	.25	.48	.28
Check	.40	.63	.23	.26	.51	.17
Check + compost . .	.33	.47	.19	.26	.30	.28

Table 16. Yield of Oven-Dry Plants Grown on Norfolk Sandy Loam Soil 8 Months after Herbicide Treatment.

Herbicide treatment	Yield of oven-dry plants per carton								
	Soil from 0-6" depth			Soil from 6-12" depth			Soil from 12-18" depth		
	Cotton	Soybeans	Oats	Cotton	Soybeans	Oats	Cotton	Soybeans	Oats
	g	g	g	g	g	g	g	g	g
Bromacil	.16	.33	.04	0	.25	.02	0	.27	.04
Bromacil + compost . .	.06	.32	.03	.17	.37	.01	0	.18	.03
Pickoram	.04	0	.28	0	0	.10	0	0	.07
Picloram + compost . .	.18	.08	.34	.12	0	.29	.09	0	.16
Fluometuron	.48	.75	.14	.43	.66	.21	.49	.81	.24
Fluometuron + compost .	.52	.38	.10	.45	.33	.13	.44	.55	.16
Simazine	.16	.65	.20	.13	.45	.28	.46	.63	.30
Simazine + compost . .	.44	.41	.15	.47	.82	.25	.31	.66	.24
Trifluralin	.21	.35	.13	.26	.53	.15	.38	.64	.25
Trifluralin + compost .	.37	.26	.06	.41	.25	.21	.44	.23	.31
Check	.26	.52	.26	.52	.46	.33	.40	.57	.28
Check + compost . .	.44	.89	.33	.39	.71	.29	.50	.44	.26

was slight growth on the Norfolk soil, especially in the 0-6" surface soil. Apparently picloram moved out of the surface soil to a considerable extent. While oats were more tolerant of picloram, their growth in subsoil samples was reduced below the controls.

Cotton and soybeans in fluometuron-treated soil responded to compost, but this effect was confined to the 0-6" depth of Decatur clay loam. Oats showed fluometuron toxicity down to 12" in both soils and this was not modified by compost.

Simazine was injurious to all three crops in Decatur soil with little if any effect of compost. Simazine effects in Norfolk soil were slight and followed no distinct pattern.

Compost enhanced the growth of all crops in trifluralin-containing Decatur soil. In Norfolk soil there was little difference between composted and non-composted soil containing trifluralin.

SUMMARY OF EFFECTS OF COMPOST ON HERBICIDE TOXICITY

1. Bromacil and picloram showed strong phytotoxicity not responsive to compost addition. These materials appeared to be dissipated by movement into the subsoil.

2. Fluometuron and trifluralin toxicity were markedly reduced by addition of compost such that near normal crop growth was obtained within 2 years of herbicide application. The amelioration of toxicity occurred too rapidly after incorporation of compost to result from stimulus to microbial degradation of the herbicide. More likely, the rapid loss of toxicity resulted from a physical adsorption of the herbicide by the compost which removed it from biological activity. Perhaps the chemical nature of fluometuron and trifluralin favored their attraction and retention by organic matter of the compost.

3. Simazine lost toxicity without apparent influence of the compost. This suggested that a major loss process of simazine was non-biological and unresponsive to increased microbial activity.

Use of Compost in Establishment of Fine Turfgrasses

Various organic materials are used as amendments to modify soils for better production of fine turf on golf courses, athletic fields, home lawns, and other areas receiving heavy traffic. The primary reason for use of organic matter is to improve the physical and chemical properties of soil and thereby improve water relationships and nutrient supplying capacities. The objectives of this experiment were to compare the original garbage compost with rotted sawdust as soil amendments for establishment of bermudagrass and to determine the value of the compost as a source of nitrogen for the grass.

The experiment was conducted on Chesterfield sandy loam soil. A soil test prior to establishment showed a pH of 5.9 with high levels of both phosphorus and potassium. The area was fumigated with methylbromide, broken deeply several times with a bermuda plow and turned. A broadcast per acre application of 1 ton of lime, 100 pounds of nitrogen, 44 pounds of phosphorus, and 83 pounds of potassium was made.

Next the area was disked and dragged smooth and compost or sawdust spread uniformly over the appropriate plots. The compost and sawdust were then incorporated into the soil to a depth of approximately 6 inches.

The area was smoothed and one-half the area was sprigged to Tifdwarf bermudagrass and the other half to Tiflawn variety. Grass sprigs were set in rows 12 inches apart and placed at 6-inch intervals in the row. After planting the area was rolled to attain a smooth level surface. The grass was watered and mowed as needed. One-half of the area received five additional topdressings of nitrogen each season at the rate of 80 lb of nitrogen per acre applied at each application.

Ratings and measurements of color and coverage were made during a period of 2 years. Measurement of growth of individual sprigs made 6 weeks after planting showed that when additional nitrogen was not supplied both compost and sawdust were detrimental to growth of both varieties of bermuda, Table 17. Additions of nitrogen alleviated the problem in the case of sawdust but did not completely overcome the adverse effects of the compost on Tifdwarf bermuda.

Ratings made 100 days after planting showed that sawdust was more injurious to both the bermudas than was compost. The addition of nitrogen offset almost completely the effects of compost on both color and coverage, Table 18. The plots receiving sawdust consistently rated lower for color even when nitrogen was supplied. The most plausable explanation was that the sawdust was undergoing more active decomposition thus immobilizing more soil nitrogen. Another possibility was the release of toxic materials from the sawdust.

The deleterious effect of the sawdust was evident on both grasses throughout the 2-year period. Some beneficial effects from the compost treatments were noted during the second season. Evidently the compost was supplying a small amount of nitrogen which improved the color over that obtained from the unamended soil, Table 19. Coverage rate was not affected as greatly by the compost as was the color.

Soil samples collected during January and November of the second season showed no changes in phosphorus, potassium or pH from any treatments. This was to be expected as the area was limed and adequately fertilized at the beginning. Also the soil tested high in phosphorus and potassium at the outset.

No measurements of soil compaction were made; however, the soil on areas receiving amendments were noticeably less compacted.

Table 17. Effects of Incorporated Sawdust and Garbage Compost on Rate of Spread of Two Hybrid Bermudagrasses

Amendment Type	Amendment Volume in ft^3 per yd^2 of area	Diameter[1/] of Tifdwarf Plants[2/] No N	Diameter[1/] of Tifdwarf Plants[2/] N added
		in.	in.
Compost	0.75	10.85	8.92
Compost	2.25	8.86	8.56
Sawdust	0.75	9.58	9.25
Sawdust	2.25	6.78	10.53
No amendment		11.75	11.05

Amendment Type	Amendment Volume in ft^3 per yd^2 of area	Diameter[1/] of Tiflawn Plants[2/] No N	Diameter[1/] of Tiflawn Plants[2/] N added
		in.	in.
Compost	0.75	12.16	21.62
Compost	2.25	13.52	19.96
Sawdust	0.75	14.42	20.47
Sawdust	2.25	13.92	21.92
No amendment		20.21	20.49

[1/] Measurements are an average of the greatest diameter in inches of 10 plants per plot.

[2/] Sprigs were planted June 20 and measurements made August 7.

Table 18. Effects of Incorporated Sawdust and Garbage Compost on Color and Coverate[1] 100 Days after Planting

	Color ratings[2]			
	Tiflawn		Tifdwarf	
Treatment	No N	N	No N	N
Compost	3.3	10.0	5.5	10.0
Compost	3.5	10.0	6.0	10.0
Sawdust . . .	1.3	10.0	2.5	10.0
Sawdust	2.0	9.3	0.5	10.0
No amendment	4.5	10.0	5.3	10.0
	Color ratings[3]			
	No N	N	No N	N
Compost	3.8	9.5	5.0	6.8
Compost	3.8	9.8	5.0	6.8
Sawdust	4.5	9.5	4.8	8.5
Sawdust	1.5	8.0	1.0	7.8
No amendment	6.8	9.8	7.3	8.3

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[1] Ratings were made during September of the first season.

[2] Color ratings: 1 = lightest green; 10 = darkest green

[3] Cover ratings: 1 = less than 10%; 10 = 100% coverage

Table 19. Color and Coverage Ratings of Two Bermudagrasses at Several Dates During the Second Season

Treatment	Color Ratings[1/]					Coverage Ratings[2/]					
	Tiflawn			Tifdwarf		Tiflawn			Tifdwarf		
	Apr. 9	May 16	Aug. 5	May 16	Aug. 5	Apr. 9	May 16	Dec. 5	Apr. 9	May 16	Dec. 5
					No additional nitrogen applied						
Compost . . .	2.5	3.5	4.5	6.6	5.0	9.0	8.0	9.8	4.5	5.5	9.5
Compost . . .	5.5	6.0	5.0	6.0	6.0	8.5	7.0	9.8	5.0	5.5	9.3
Sawdust . . .	1.0	2.0	3.0	3.0	4.0	8.5	6.5	9.8	1.5	3.5	9.0
Sawdust . . .	5.0	4.5	3.5	1.5	1.0	6.5	4.5	9.5	1.0	1.5	8.8
No amendment	4.5	5.5	4.0	4.5	3.5	10.0	9.5	10.0	2.5	4.5	9.0
					Nitrogen applied as needed						
Compost . . .	10.0	10.0	10.0	9.5	9.5	9.5	10.0	10.0	7.0	8.5	10.0
Compost . . .	10.0	10.0	10.0	10.0	9.5	10.0	10.0	10.0	7.0	9.0	10.0
Sawdust . . .	10.0	9.0	9.0	8.5	9.0	10.0	10.0	10.0	6.5	8.0	10.0
Sawdust . . .	10.0	8.0	9.0	8.5	9.0	10.0	10.0	10.0	7.0	8.5	10.0
No amendment	10.0	10.0	9.0	9.0	9.0	10.0	10.0	10.0	7.0	9.5	10.0

[1/] Color ratings: 1 = lightest green; 10 = darkest green

[2/] Cover ratings: 1 = less than 10% coverage; 10 = 100% coverage

Conclusions: Frequent applications of nitrogen were necessary to maintain adequate growth and color of Tifdwarf and Tiflawn bermuda when either compost or sawdust were used as a soil amendment. During the second season after establishment compost released a small amount of nitrogen to the grasses; whereas, sawdust continued to create a nitrogen deficit.

Compost on Roadsides

Experiments were conducted at 5 locations in Alabama to determine the value of compost in establishing vegetation on roadsides where conventional methods had failed. A brief description of each area is presented below.

Battleship Parkway (BSP ROW)

The area was composed of beach sand overlayed with a 6-8-inch layer of silty topsoil. The topography was smooth and level. The water table on this area was approximately 40 inches below the soil surface. The area was located at Battleship Parkway, Mobile, Alabama.

Stapleton

This area consists of strip of median on U. S. 31 4 miles north of its intersection with Alabama Highway 59. The area slopes from each highway lane to a drainage canal in the center of the median. The degree of slope varies considerably along the test area. Plots were laid out across both slopes from pavement to pavement. Soil on the area varied from clay subsoil on the upper portions of the slopes to deep sandy loam near the bottom of the slopes. The area had been vegetated a few years before when the road was constructed but the cover plants failed to survive.

Spanish Fort

The area was located on Alabama Highway 225, near Spanish Fort, Alabama. The area consisted of highway back slopes primarily composed of subsoil and parent material of the Cuthbert soil series. Sandstone in varying degrees of weathering was abundant.

Daleville

The area was located on Alabama Highway 92 on the bridge approach to Choctawhatchee River west of Daleville, Alabama. The soil type in the general area was a Huckabee fine sand. The soil on the test area consisted of topsoil and subsoil used for fill on the bridge approach. The plots were located on steep front slopes on each side of the pavement.

Athens

This experiment was on the backslopes of U.S.-31, 7 miles north of the Tennessee River bridge at Decatur, Alabama. The soil was Decatur clay.

Experimental Procedure

The areas were reshaped to highway specifications with road building equipment. Lime was applied to each area in sufficient quantities to raise the pH into an acceptable range for plant growth. A broadcast application of one ton per acre of 8-8-8 fertilizer was applied to all plots except treatment 15 which received one ton of 0-8-8 fertilizer, Table 20. The plots varied in dimensions with location and were from 2,000-4,000 square feet in size. After application of compost and sawdust the entire area was disked to incorporate the added amendment.

The four southern Alabama locations were seeded with 'Pensacola' bahiagrass (Paspalum notatum Flugge) at 50 lb/A, 'Sericea' lespedeza (Lespedeza cuneata (Dumont) G. Don) at 25 lb/A, weeping lovegrass (Eragrostis curvula (Schrad.) Nees) and corn at 50 lb/A. On the median area near Stapleton, 'Kobe' annual lespedeza (Lespedeza striata (Thunb.) Hook. and Arn.) was substituted for sericea and the weeping lovegrass was omitted. The Athens

Table 20. Treatments Used in Experiments with Compost on Roadsides

Treatment No.	Amendment		Annual[1/] N topdressing lb/A	Mulch applied
	Type	Volume in ft.^{3} per yd.^{2} of area		
1	Compost	0.75	0	Straw
2	Compost	0.75	80	Straw
3	Compost	0.75	400	Straw
4	Compost	2.25	0	Straw
5	Compost	2.25	80	Straw
6	Compost	2.25	400	Straw
7	None	None	0	Straw
8	None	None	80	Straw
9	None	None	400	Straw
10	Sawdust	2.25	0	Straw
11	Sawdust	2.25	80	Straw
12	Sawdust	2.25	400	Straw
13	Compost	0.38	80	Compost
14	None	None	80	None
15	Compost	2.25	0	Straw

1/ The 80-pound rate was applied in one spring application. The 400-pound rate was applied in 5 applications of 80 lb/A each during growing season. One ton/A of 8-8-8 applied the first year to all treatments except No. 15 which received one ton/A of 0-8-8.

experiment was seeded to 50 lb./A of Kentucky-31 tall fescue and 25 lb./A of 'Emerald' crownvetch (Coronilla varia L.).

Stand counts and ratings were used to evaluate the effects of the various treatments on the plant establishment and growth. Soil samples were taken from all plots at various time intervals to determine the rate and amount of nutrient release.

The time of establishment and weather conditions varied considerably with locations; therefore, each location is considered separately.

Battleship Parkway

The sawdust treatments were omitted from this area. The experiment was planted June 19, and 24 days after seeding it was noted that stands were very poor on plots receiving compost. Stand ratings made on July 29 showed that grass species were adversely affected more than sericea lespedeza, Table 21. The whole area was reseeded in August with 50 lb./A of bahiagrass, 25 lb./A of sericea and 5 lb./A of weeping lovegrass. No covering of the seed or re-mulching was done. Ratings made 15 days after reseeding showed little improvement in stands.

Cover and appearance ratings made in April of the second year reflected the poor stands on areas which received compost, Table 22. However, differences were not as great as in the preceding fall. The appearance of the plants on the compost plots were equal or superior to plants on areas receiving no compost. It appeared that most of the deleterious effects from the compost had dissipated by the second year.

Ratings made in May and September of the second season showed that the best growth and color were found on areas which received high rates of nitrogen regardless of the amendment used. Color or appearance of the compost plots with no added nitrogen was superior to plots receiving either 0 or 80 lb./A

Table 21. Stand Ratings[1/] on Compost Test Vegetation Planted June 19 on Battleship Park Right-of-Way, Mobile, Alabama

Treatment No.	Sericea		Bahia		Corn		Lovegrass
	July 29	Sept.12	July 29	Sept.12	July 29	Sept.12	July 29
1. . .	6.5	5.5	1.5	5.5	1.0	2.0	1.0
2. . .	6.5	5.5	6.0	5.5	1.0	2.0	1.0
3. . .	6.5	5.5	4.0	5.5	1.0	2.0	1.0
4. . .	6.0	2.5	1.0	1.0	1.0	1.0	1.0
5. . .	7.5	2.5	4.0	1.0	1.0	1.0	1.0
6. . .	7.0	2.5	4.0	1.0	1.0	1.5	1.0
7. . .	7.0	1.0	1.0	1.0	1.0	3.5	8.5
8. . .	7.5	1.0	9.5	1.0	1.0	5.0	7.5
9. . .	8.0	1.0	9.5	1.0	1.0	3.5	6.5
13. . .	1.0	1.0	9.5	1.0	8.0	3.5	8.5
14. . .	7.5	1.0	1.0	1.0	1.0	4.5	9.5
15. . .	1.0	4.0	1.0	5.5	8.0	1.0	1.0

[1/] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

Table 22. Cover and Appearance Ratings on Compost Test at Battleship Park Right-of-Way, Mobile, Alabama

Treat-ment	Cover ratings[1/]		Color ratings		
	8 months after seeding[2/]	13 months after seeding[2/]	8 months after seeding	10 months after seeding	13 months after seeding
No.					
1. . .	4.5	9.0	7.0	7.5	7.0
2. . .	3.5	9.5	6.0	8.5	7.5
3. . .	3.0	8.5	6.0	10.0	9.5
4. . .	2.0	8.5	6.5	7.5	7.5
5. . .	3.5	8.8	7.5	10.0	7.5
6. . .	3.5	8.8	7.5	10.0	10.0
7. . .	9.5	8.0	1.0	1.0	3.0
8. . .	6.5	9.5	6.5	7.0	6.0
9. . .	7.5	9.0	7.0	10.0	9.0
13. . .	5.5	9.0	5.5	6.0	6.0
14. . .	5.0	8.5	8.0	7.5	7.5
15. . .	6.0	8.5	7.5	6.0	8.0

[1/] Cover ratings: 1 = less than 10% coverage; 10 = 100% coverage

[2/] Color ratings: 1 = lightest green; 10 = darkest green of N and no compost amendments. This indicated that the compost amendment was contributing beneficial effects equal to at least an 80 lb./A application of nitrogen the second season after application.

By the spring of the third season there was a uniform stand of vegetation over the whole area. The only noticeable differences were color differences as the result of the nitrogen applications.

Stapleton

The amendments were applied and the area seeded during June. Stands, 22 days after seeding, were excellent on all areas except the compost mulch and the no mulch treatments, Table 23. Erosion caused the poor stands on these areas. The no mulch plot eroded badly in both series and the compost mulch plot eroded in one replication but not on the other. No erosion occurred on any of the other treatments.

Growth was noticeably less on the plots receiving 3 inches of compost. Some dead seedlings were noted on these plots at this time.

Stands rapidly deteriorated on all plots and 60 days after planting the only plots having more than a 50% stand were no mulch and compost mulch plots. The most severe reductions in stands were on plots receiving compost as a soil amendment.

The entire area was seeded again in August with 50 lb./A of bahiagrass and 25 lb./A of common bermudagrass. Ratings made 2 weeks later showed poor stand persisting on the area receiving compost. There was little difference in stands just prior to the first killing frost in October indicating that the effect of compost on stands was rapidly diminishing.

Ratings of bahia stands in 5 months after replanting showed that the best stands were on plots receiving the no mulch or compost mulch but differences in stands were not large at this time, Table 24. Individual plant

Table 23. Effect of Soil Amendments on Emergence of Survival of Vegetation Summer and Fall[1] of the First Season, U.S.-31 Near Stapleton, Alabama

Treat-ment	Ratings of stands[2]									
	July 13		July		August		September		October	
	I	II	I	II	I	II	I	II	I	II
No.										
1. .	10	10[1]	3	2	2	2	6	6	6	6
2. .	10	10	3	2	2	2	6	6	6	6
3. .	10	10	2	2	2	2	6	6	6	6
4. .	10	10	1	1	2	2	3	3	8	8
5. .	10	10	1	1	2	2	3	3	8	8
6. .	10	10	1	1	2	2	3	3	8	8
7. .	10	10	7	1	5	2	10	10	7	3
8. .	10	10	6	1	5	2	10	10	7	3
9. .	10	10	8	1	5	2	10	10	7	3
12. .	10	10	7	6	5	2	10	10	7	8
13. .	10	6	8	9	8	8	10	10	10	10
14. .	10	6	6	6	8	8	10	10	10	10
15. .	10	10	1	1	2	2	6	3	6	8

[1] Area seeded in June and reseeded in August.

[2] Stand ratings: 1 = less than 10% stand; 10 = 100% stand.

Table 24. Stand and Appearance Ratings the Second Year After Planting on the Compost Test on U.S.-31 Near Stapleton, Alabama

Treatment	Stand ratings[1/]			Appearance[2/] ratings
	Bahia		Bermuda	
	5 mo. after planting	13 mo. after planting	13 mo. after planting	13 mo. after planting
No.				
1. . . .	5.0	6.0	1.5	3.5
2. . . .	6.5	6.0	1.5	4.0
3. . . .	6.5	3.5	4.5	5.0
4. . . .	7.5	5.0	3.5	4.0
5. . . .	8.5	6.5	4.0	4.0
6. . . .	8.0	3.5	7.5	5.0
7. . . .	5.0	7.5	1.5	2.5
8. . . .	6.0	8.5	1.0	4.0
9. . . .	7.0	8.0	1.5	5.0
12. . . .	8.5	9.0	1.5	5.0
13. . . .	9.5	9.5	1.0	3.0
14. . . .	10.0	7.5	1.0	3.0
15. . . .	7.0	6.5	4.0	4.5

[1/] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

[2/] 5 = excess growth; 3 = optimum growth for highway conditions; 1 = sparse growth.

counts showed no differences among any treatments in the number of plants per unit area. Ratings made 13 months after planting showed that the treatments did affect the composition of plants on the areas. Plots receiving high rates of nitrogen had more bermuda as compared to bahiagrass. Also plots receiving compost contained more bermudagrass and less bahia than those receiving sawdust or no amendment.

The high rates of nitrogen produced excess growth for highway conditions throughout the year. The high rates of compost without additional nitrogen also produced excessive growth indicating beneficial effects from the compost occurred during the second year.

There was essentially no visual difference in the response of the various treatments during the third year. All plots had excellent stands of grass and the only noticeable differences were from nitrogen fertilization.

Spanish Fort

This test was established and seeded in June. Ratings made 1 month later showed extremely poor stands of sericea, bahia and corn on plots receiving compost, Table 25. Marginal to adequate stands were obtained on all other plots. Stands of weeping lovegrass were very poor on all plots at this time. The area was reseeded in August to all species except corn. Stands of sericea and bahia were improved on all plots. There was no effect at all from the compost on sericea stands in November. Stands of bahia were reduced somewhat by the compost and lovegrass was completely eliminated on most plots receiving compost.

Cover ratings made in April of the second season showed that stands on compost plots were still poor at that time but not as sparse as on the sawdust treatments, Table 26. Nitrogen applications increased cover on all plots except the sawdust amended plots.

Table 25. Stand Ratings the First Season After Seeding in June and Reseeding in August on Ala.-225, Spanish Fort, Alabama

Treatment	Stand ratings[1]					
	Sericea		Bahia		Corn	Lovegrass
	July	Nov.	July	Nov.	July	November
No.						
1. . .	4	10	3	7	5	1
2. . .	3	10	2	7	3	1
3. . .	1	10	1	7	1	1
4. . .	1	10	1	7	1	1
5. . .	1	10	1	7	2	1
6. . .	2	10	2	7	2	1
7. . .	9	10	6	9	7	9
8. . .	9	10	10	10	8	9
9. . .	10	10	10	10	8	9
10. . .	10	1	1	5	3	1
11. . .	10	10	2	6	3	1
12. . .	10	10	1	6	5	6
13. . .	8	10	5	9	5	7
14. . .	6	7	6	5	3	5
15. . .	4	10	2	7	3	6

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[1] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

Additions of nitrogen resulted in marked differences in species composition. On compost amended plots receiving 400 lb./A nitrogen the predominate species was bahia; whereas, on the sawdust amended plots sericea was the main species regardless of nitrogen rate. Areas which received high rates of compost without added nitrogen had more bahia than any of the other no nitrogen treatments and as much as the sawdust plots which recieved 400 lb./A of nitrogen. Sericea stands were generally inversely related to nitrogen added.

Extreme erosion occurred on the unmulched plots. Compost applied as a mulch reduced the erosion to some degree but complete control was not obtained.

Daleville

The best initial stand after seeding in July was obtained on the plots where compost was applied as a mulch. The poorest stands were on the no mulch plots, Table 27.

Erosion occurred on the low rate of compost and the no mulch plots. Stands on all plots deteriorated shortly after emergence. The most damage was evident on the compost plots. The area was reseeded in August.

Excellent stands of sericea and bahia were obtained on the east series of plots except those receiving the 3-inch layer of compost. Sericea stands were poor on the west side. Again the adverse effect of the compost was evident, Table 28. Bahia stands on the west side were poor on all plots receiving either sawdust or compost. No explanation can be given for the drastic differences in stands between the two areas. However, extreme differences in soil were evident as in all roadside experiments.

The area was overseeded with emerald crownvetch in October and there was an adequate stand of crownvetch on all plots by December with a tendency

Table 26. Cover Ratings on Bahia and Sericea on the Compost Test During the Second Year on Ala.-225 Near Spanish Fort, Alabama

Treatment	Cover ratings[1/]		
	Bahia	Bahia	Sericea
No.	April	September	September
1.	5.5	2.0	9.5
2.	5.0	6.5	7.0
3.	5.5	7.5	5.0
4.	4.5	6.0	5.5
5.	3.0	5.0	3.5
6.	7.0	5.0	6.0
7.	3.5	2.5	5.0
8.	8.5	10.0	2.5
9.	9.0	8.5	4.5
10.	2.0	1.0	10.0
11.	3.0	2.0	9.0
12.	2.0	5.0	8.0
13.	6.0	5.0	2.5
14	4.0	3.5	1.0
15	6.0	3.5	8.5

[1/] Cover ratings: 1 = less than 10% coverage; 10 = 100% coverage

Table 27. Stand Ratings 9 Days After Seeding on Ala.-92 Near Daleville, Alabama

Treatment	Stand ratings[1] in August		
	Bahia	Sericea	Lovegrass
No.			
1.	6	4	6
2.	6	4	6
3.	6	4	6
4.	6	2	3
5.	6	2	3
6.	6	2	3
7.	6	6	6
8.	6	6	6
9.	6	6	6
10.	6	5	6
11.	6	5	6
12.	6	5	6
13.	10	10	10
14.	1	1	1
15.	6	3	6

---

[1] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

Table 28. Stand Ratings 43 Days After Reseeding on Ala.-92 Near Daleville, Alabama

Treatment No.	Stand ratings[1] in October: West side, Sericea	West side, Bahia	East side, Sericea	East side, Bahia
1.	5	5	9	8
2.	5	5	9	8
3.	5	5	9	8
4.	1	1	6	4
5.	1	1	6	4
6.	1	1	6	4
7.	6	9	9	8
8.	6	9	9	8
9.	6	9	9	8
10.	6	1	9	8
11.	6	1	9	8
12.	6	1	9	8
13.	5	9	9	8
14.	1	9	9	8
15.	1	1	6	4

[1] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

toward denser stands on the compost amended plots, Table 29. Counts made in May of the next year showed a decrease in density of crownvetch plants on the areas but stands were still adequate. By August of the second season crownvetch stands were by far the best on plots receiving compost. Nitrogen applications also stimulated growth of crownvetch even though the species is capable of symbiotically fixing nitrogen from the atmosphere.

Stands of bahiagrass were adequate but somewhat variable on all plots by May the second season, Table 30. Generally the best stands were on plots receiving neither compost nor sawdust. Sericea and lovegrass stands were poor. Sericea was most abundant on the sawdust and compost mulch plots. Stands of lovegrass were best on the compost mulch and no mulch plots.

By August of the second year sericea dominated the sawdust amended plots which received little or no nitrogen, Table 31. Bahia dominated on all other plots. Crownvetch did not survive the summer on any plots except those receiving compost. By December of the second year the entire area, regardless of plant species or treatment, had from 70 to 100% ground cover. From this time on there was little change in plant coverage.

Athens

Soil amendments were applied in May and the area seeded the following day. Initial stands of fescue and crownvetch were satisfactory, Table 32. Compost applied as a mulch tended to decrease stands of both species.

A severe drought all but eliminated fescue from the test area during the first summer. The area was reseeded with fescue at 50 lb./A in October and the fescue was up to a good stand by late November.

Fescue stands were variable by April of the second year with best stands appearing on plots receiving high nitrogen rates, Table 33. Crownvetch stands

Table 29. Crownvetch Stand Counts and Ratings on Compost Test on Ala.-92 Near Daleville, Alabama

Treatment	Plants per ft^2		Stand ratings[1/]	
	First year December 27	Second year May 23	Second year August 13	Second year September 10
No.				
1.	2.45	1.00	3.5	1.0
2.	3.15	1.30	3.5	4.0
3.	2.80	0.85	7.5	3.0
4.	3.70	1.25	5.5	3.0
5.	4.85	1.90	6.5	6.0
6.	5.30	1.85	10.0	7.0
7.	2.45	0.50	2.0	1.0
8.	2.80	1.35	2.0	1.0
9.	2.20	1.50	5.5	3.0
10.	2.30	0.25	1.0	1.0
11.	3.55	1.10	1.0	1.0
12.	1.40	0.55	7.5	1.0
13.	2.40	1.20	3.0	1.0
14.	2.10	1.15	3.0	1.0
15.	0.80	1.05	4.5	3.0

[1/] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

Table 30. Stand Counts in May of the Second Year on Ala.-92 Near Daleville, Alabama

Treatment	Plants per ft^2		
	Bahia	Sericea	Lovegrass
No.			
1.	11.75	1.95	0.0
2.	5.30	0.50	0.0
3.	6.35	0.70	0.1
4.	5.10	1.20	0.4
5.	5.45	0.75	0.4
6.	4.30	0.50	0.3
7.	8.25	1.15	0.6
8.	8.75	1.55	0.3
9.	11.70	2.10	0.4
10.	3.35	4.95	0.4
11.	2.25	2.80	0.0
12.	7.45	2.25	0.0
13.	13.20	3.60	7.4
14.	9.40	1.85	1.7
15.	5.90	0.90	0.2

Table 31. Stand Ratings by Species on Compost Test on Ala.-92 Near Daleville, Alabama[1/]

Treatment	First year		Second year			
	December		August		September	
	Bahia	Lovegrass	Bahia	Sericea	Bahia	Sericea
No.						
1. . .	5.0	1.5	5.0	3.0	10.0	1.5
2. . .	6.5	1.5	5.0	3.0	8.0	1.0
3. . .	7.5	1.5	10.0	1.0	7.0	1.0
4. . .	2.5	1.5	6.0	2.0	7.0	1.5
5. . .	3.5	1.5	6.0	2.0	5.0	1.0
6. . .	4.0	1.5	10.0	1.0	2.0	1.0
7. . .	5.0	3.0	2.5	2.0	7.0	1.5
8. . .	5.5	3.0	2.5	2.0	8.0	2.0
9. . .	6.0	2.0	9.0	2.0	10.0	1.5
10. . .	2.0	1.0	1.0	10.0	3.0	5.0
11. . .	2.5	1.0	3.5	8.5	3.0	4.0
12. . .	2.5	1.0	10.0	5.5	6.0	1.5
13. . .	8.0	6.5	3.5	1.5	6.0	1.5
14. . .	6.5	7.5	3.5	1.5	4.0	1.0
15. . .	4.5	2.0	5.5	1.5	6.0	1.0

[1/] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

Table 32. Stand Counts 26 Days After Seeding on Compost Test on U.S.-31, Athens, Alabama

Treatment	Stand counts in plants per ft^2	
	Fescue	Crownvetch
No.		
1.	52.8	23.6
2.	60.3	27.3
3.	56.9	24.0
4.	58.5	22.0
5.	64.1	22.2
6.	59.0	21.7
7.	64.0	22.4
8.	50.5	26.7
9.	56.0	22.2
12.	53.0	27.1
13.	46.0	16.8
14.	51.0	20.6
15.	63.0	24.4

Table 33. Stand of Crownvetch and Fescue During the Second Season on U.S.-31 at Athens, Alabama

Treatment	Crownvetch	Fescue
	Plants per ft^2	Stand rating[1]
No.		
1.	59	1
2.	59	3
3.	52	4
4.	39	5
5.	56	6
6.	47	6
7.	40	4
8.	46	6
9.	42	8
12.	40	10
13.	39	5
14.	39	3
15.	50	3

[1] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

were affected by location to a large degree. No differences from the treatment were noted. During the remainder of the season the only noticeable effects were from nitrogen applications and location.

Compost for Establishment of Vegetation on Beach Sand Fill

The objectives were to determine the value of composted garbage in the establishment of several plant species on beach sand.

The test area consisted of sand and sediment pumped out of Mobile Bay for a park area adjacent to the Battleship USS Alabama on Battleship Parkway in Mobile. The area was extremely variable in texture with sizable areas of sand interspersed with areas of heavy clay. The area would not support soil tillage equipment. Auxiliary tractors had to be used in the land preparation.

Soil tests taken prior to initiation of treatments showed the soil to be almost devoid of available calcium, magnesium, and phosphorus. Potassium content was about 30 lb./A and the pH varied from 4.2 to 6.1.

Treatments used on this area were the same as on Roadside tests except no sawdust treatments were included and the area was not mulched. Corn was broadcast over the area as a companion crop.

Plant species planted were as follows: weeping lovegrass; bahiagrass; centipede grass (*Eremochloa ophiuroides* (Munro) Hack.); and a mixture of bahia, weeping lovegrass, and sericea. Seeding was completed in June. Three 6-inch rains occurred within 90 days after seeding.

Stand ratings made in August showed good stands of all species on all plots, Table 34. This situation continued throughout the remainder of the growing season.

Bahiagrass became the dominant plant on the area early in the second season. Lovegrass all but disappeared. The centipede experienced die-back

Table 34. Stand Ratings Made 2 Months After Seeding on Beach Sand at Battleship Parkway, Mobile, Alabama

Treatment	Stand ratings[1/] made in August			
	Bahia	Centipede	Lovegrass	Mixture
No.				
1.	9	9	9	6
2.	9	8	6	6
3.	9	7	6	7
4.	8	4	10	6
5.	7	4	8	6
6.	7	4	8	4
7.	9	5	10	7
8.	8	6	9	6
9.	8	4	8	5
13.	9	6	5	8
15.	7	5	2	4

[1/] Stand ratings: 1 = less than 10% stand; 10 = 100% stand

during the winter and did not make appreciable growth during the next season although the plants remained alive.

Appearance ratings made during the second year showed that nitrogen was the most important factor affecting plant appearance on this area, Table 35. By fall of the second-year plots receiving compost but no nitrogen were superior to the plots receiving no compost and 80 lb./A of nitrogen. Cover was essentially complete by midsummer of the second year on all plots except those receiving neither nitrogen nor compost.

Results during the third season were essentially the same as in the second year. Excellent bahiagrass sod formed on all plots except the no nitrogen and the no compost plots.

Effects of Compost on Available Soil Potassium and Phosphorus and on Soil pH

Soil test data obtained from samples taken on establishment tests at four locations in southern Alabama were anlyzed statistically using locations as replications and the duplicate sets of plots at each location as subsamples.

Prior to adding treatments all these test locations had extremely low phosphorus and pH values, Table 36.

The extreme variability existing within each location because of the nature of the test sites made precise evaluation difficult. However, differences in fertility status resulting from treatment were obtained.

Available soil phosphorus was higher on plots receiving compost than on those receiving no amendment 7 months after application, Table 37. There was no difference in phosphorus levels between the 0.75 ft^3 and 2.25 ft^3 per yd^2 compost treatments although there was a trend toward higher values for the higher rate. The 0.38 ft^3 rate as a mulch was not different from the other compost treatments or from the plots receiving no compost.

Table 35. Color and Cover Ratings on the Compost Test on the Sandy Areas of Battleship Park, Mobile, Alabama

Treatment	Color ratings[1/]			Cover[2/]
	April	May	July	July
No.				
1. . . .	5.0	3.0	2.3	7.5
2. . . .	10.0	7.0	4.6	9.5
3. . . .	10.0	10.9	9.6	10.0
4. . . .	7.0	5.0	5.3	8.5
5. . . .	10.0	7.0	6.6	9.5
6. . . .	10.0	10.0	8.3	9.8
7. . . .	1.0	1.0	1.0	2.0
8. . . .	8.0	7.0	3.6	6.0
9. . . .	8.0	10.0	10.0	8.5
13. . . .	10.0	7.0	4.3	65.
14. . . .	10.0	6.0	3.0	7.0
15. . . .	8.0	5.0	6.6	9.5

[1/] Color ratings: 1 = lightest green; 10 = darkest green

[2/] Cover ratings: 1 = less than 10% coverage; 10 = 100% coverage

Table 36. Initial Soil Test Values at Four Locations in South Alabama

Location	pH	Phosphorus	Potassium
		Lb./A	Lb./A
Battleship park roadside . .	5.0	7	84
Battleship park (sand fill) . . .	4.9	1	32
Stapleton	5.2	8	75
Spanish Fort	4.8	3	38

Table 37. Effect of Composted Garbage on Phosphorus Soil Test Values January, 7 Months after Treatments were Applied, at Four Locations in South Alabama

Amendment		Annual rate of N		Available soil phosphorus[1] in lb/A				
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	BSP ROW	BSP	Stapleton	Spanish Fort	Average[2]
Compost . .	0.75	0	Straw	167.5	91.5	119	86	116 abcd
Compost . .	0.75	80	Straw	110	107.5	190	177.5	146.25 ab
Compost . .	0.75	400	Straw	123.5	136	177.5	132.5	142.38 abc
Compost . .	2.25	0	Straw	147	210.5	237	46.5	160.25 a
Compost . .	2.25	80	Straw	155	240	168	122.5	171.38 a
Compost . .	2.25	400	Straw	162.5	205	168	24	139.88 abc
None . . .	--	0	Straw	44	104	108	67.5	80.88 cd
None . . .	--	80	Straw	57	128	110	67	90.5 bcd
None . . .	--	400	Straw	54	129	111	57	87.75 bcd
Compost . .	0.38	80	Compost	76.5	116	126	144	115.63 abcd
None . . .	--	80	None	51.5	61	101.5	64	69.5 d
Compost . .	2.25	0	Straw	95	131	143	80.5	137.38 abc

[1] All treatments received 70 lb. of phosphorus in fertilizer

[2] Averages not followed by a common letter are significantly different at the 5% level of probability

Results of samples taken in November, 18 months after application, showed generally less variation within compost treatments and a more distinct break between compost and no compost treatments, Table 38. Again, the phosphorus values for compost treated areas were higher than no compost areas. Available phosphorus on the compost treated areas ranged from 120 to 140 lb./A while the areas receiving no compost had 54-68 lb./A.

Results for potassium in January, 7 months after application, were similar to those for phosphorus in that higher values were obtained on plots receiving compost, however, a rate response was evident for potassium, Table 39. Samples taken in November, 18 months after application, showed that the potassium was being exhausted from the compost treated areas either by luxury consumption or by leaching, Table 40. There was no longer a difference in amounts of available potassium between plots receiving the low rate of compost and those receiving no amendment. However, the high rate of compost was continuing to show higher values than other treatments.

Soil pH was increased by compost 7 months after application regardless of rate applied, Table 41. Eighteen months after application of treatments differences were not as apparent, Table 42. The most obvious effect was the lowering of pH by the nitrogen application regardless of amendment treatment.

The soil test results were averaged for the four southern Alabama experiments and are given in Tables 43-45 for three sampling dates. Samples taken in November, 30 months after treatments were applied showed that available soil phosphorus levels were generally unchanged from the previous year indicating that an equilibrium between total phosphorus and available phosphorus had been established. The potassium values continued to decrease on

Table 38. Effects of Composted Garbage on Phosphorus Soil Test Values November, 18 Months After Treatments were Applied, at Four Locations in South Alabama

Amendment		Annual rate of N		Available Soil Phosphorus[1] in lb/A				
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	BSP ROW	BSP	Stapleton	Spanish Fort	Average[2]
Compost . .	0.75	0	Straw	131.5	83.5	172	91.5	119.63 a
Compost . .	0.75	80	Straw	128	98.5	150	109	121.38 a
Compost . .	0.75	400	Straw	116	115	147.5	75.5	113.5 a
Compost . .	2.25	0	Straw	156	150	177.5	35	129.63 a
Compost . .	2.25	80	Straw	176	200	174.5	47	149.38 a
Compost . .	2.25	400	Straw	157.5	156	168	71.5	138.25 a
None . . .	--	0	Straw	42.5	63.5	82.5	32.5	55.25 b
None . . .	--	80	Straw	41	52	88.5	32.5	53.5 b
None . . .	--	400	Straw	43	119	51	42.5	63.88 b
Compost . .	0.38	80	Compost	57	80	95.5	15.5	62 b
None . . .	--	80	None	50	84	94.5	42.5	67.75 b
Compost . .	2.25	0	Straw	165.5	125.5	190	23	126 a

[1] All treatments received 70 lb. of phosphorus in fertilizer

[2] Averages not followed by a common letter are significantly different at the 5% level of probability

Table 39. Effects of Composted Garbage on Potassium Soil Test Values January, 7 Months After Treatments were Applied, at Four Locations in South Alabama

Amendment		Annual rate of N		Available Soil Potassium[1] in lb./A				
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	BSP ROW	BSP	Stapleton	Spanish Fort	Average[2]
Compost . .	0.75	0	Straw	170	39	154	107	117.5 bc
Compost . .	0.75	80	Straw	129.5	41	158	77.5	101.5 bcd
Compost . .	0.75	400	Straw	146	42	158	170	129 b
Compost . .	2.25	0	Straw	203.5	73.5	220.5	258	188.88 a
Compost . .	2.25	80	Straw	215	90	236	304	211.25 a
Compost . .	2.25	400	Straw	231	66	283.5	289	217.38 a
None . . .	--	0	Straw	80	49	99.5	37.5	66.5 cd
None . . .	--	80	Straw	66	51	92.5	32	60.38 d
None . . .	--	400	Straw	73	58	124	64	79.75 bcd
Compost . .	0.38	80	Compost	113	49.5	116	92.5	92.75 bcd
None . . .	--	80	None	100	41	87.5	50	69.63 cd
Compost . .	2.25	0	Straw	258.5	89	241.5	323	228 a

[1] All treatments received 132 lb. of potassium in fertilizer

[2] Averages not followed by a common letter are significantly different at the 5% level of probability

Table 40. The Effects of Composted Garbage on Potassium Soil Test Values in November, 18 Months After Treatments were Applied, at Four Locations in South Alabama

Amendment		Annual rate of N		Available soil potassium[1] in lb/A				
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	BSP ROW	BSP	Stapleton	Spanish Fort	Average[2]
Compost . .	0.75	0	Straw	140	56	122	105	108 c
Compost . .	0.75	80	Straw	164	66	130	122	121 c
Compost . .	0.75	400	Straw	152	55	124	188	130 bc
Compost . .	2.25	0	Straw	206	79	208	226	180 a
Compost . .	2.25	80	Straw	256	96	169	246	192 a
Compost . .	2.25	400	Straw	228	74	180	218	175 ab
None . . .	--	0	Straw	88	102	94	61	86 c
None . . .	--	80	Straw	77	108	80	55	80 c
None . . .	--	400	Straw	86	102	74	52	79 c
Compost . .	0.38	80	Compost	138	64	102	98	101 c
None . . .	--	80	None	160	70	94	101	106 c
Compost . .	2.25	0	Straw	239	102	197	188	181 a

[1] All treatments received 70 lb. of potassium in fertilizer

[2] Averages not followed by a common letter are significantly different at the 5% level of probability

Table 41. Effect of Composted Garbage on Soil pH in January, 7 Months After Treatments were Applied, at Four Locations in South Alabama

Amendment		Annual rate of N	Mulch	Soil test pH values				
Type	Volume in ft^3 per yd^2 of area	lb./A		BSP ROW	BSP	Stapleton	Spanish Fort	Average[1/]
Compost . .	0,75	0	Straw	6.9	7.4	7.4	7.6	7.3 ab
Compost . .	0.75	80	Straw	6.9	7.5	7.5	7.6	7.4 a
Compost . .	0.75	400	Straw	6.9	7.7	7.7	7.5	7.5 a
Compost . .	2.25	0	Straw	7.3	7.8	7.5	7.5	7.5 a
Compost . .	2.25	80	Straw	7.4	7.8	7.4	7.3	7.5 a
Compost . .	2.25	400	Straw	7.2	7.8	7.6	7.5	7.5 a
None . . .	--	0	Straw	6.7	7.5	7.4	7.0	7.2 bc
None . . .	--	80	Straw	6.2	7.1	7.2	7.1	6.9 de
None . . .	--	400	Straw	6.2	7.5	7.4	7.2	7.1 cd
Compost . .	0.38	80	Compost	6.3	7.0	7.5	7.0	7.0 de
None . . .	--	80	None	5.8	6.8	7.3	7.0	6.7 e
Compost . .	2.25	0	Straw	7.2	7.3	7.6	7.5	7.4 a

[1/] Averages not followed by a common letter are significantly different at the 5% level of probability.

Table 42. Effect of Composted Garbage on Soil pH in November, 18 Months After Treatments were Applied, at Four South Alabama Locations

Amendment		Annual rate of N lb./A	Mulch	Soil test ph values				
Type	Volume in ft^3 per yd^2 of area			BSP ROW	BSP	Stapleton	Spanish Fort	Average[1/]
Compost . .	0.75	0	Straw	6.5	7.5	7.5	7.25	7.23 bcd
Compost . .	0.75	80	Straw	6.8	7.55	7.45	7.4	7.30 abc
Compost . .	0.75	400	Straw	6.5	7.5	7.4	7.2	7.15 cde
Compost . .	2.25	0	Straw	7.1	7.7	7.5	7.5	7.45 ab
Compost . .	2.25	80	Straw	7.25	7.65	7.5	7.55	7.49 a
Compost . .	2.25	400	Straw	7.05	7.65	7.5	7.35	7.39 abc
None . . .	--	0	Straw	6.55	7.8	7.3	6.7	7.09 de
None . . .	--	80	Straw	6.1	7.55	7.25	6.8	6.92 ef
None . . .	--	400	Straw	5.65	7.15	7.2	6.95	6.74 f
Compost . .	0.38	80	Compost	6.05	7.45	7.35	7.3	7.08 de
None . . .	--	80	None	5.65	7.05	7.35	6.9	6.74 f
Compost . .	2.25	0	Straw	6.95	7.25	7.6	7.35	7.29 abcd

[1/] Averages not followed by a common letter are significantly different at the 5% level of probability.

Table 43. Effects of Composted Garbage on Phosphorus Soil Test Values at 3 Dates After Application of Compost in June

Amendment		Annual rate of N		Available soil phosphorus[1/] in lb./A		
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	after 7 months	after 18 months	after 30 months
Compost . . .	0.75	0	Straw	116	120	99
Compost . . .	0.75	80	Straw	147	121	124
Compost . . .	0.75	400	Straw	142	114	129
Compost . . .	2.25	0	Straw	160	130	148
Compost . . .	2.25	80	Straw	171	149	150
Compost . . .	2.25	400	Straw	140	138	145
None	--	0	Straw	81	55	57
None	--	80	Straw	91	54	49
None	--	400	Straw	88	64	74
Compost . . .	0.38	80	Compost	116	62	81
None	--	80	None	70	68	63
Compost . . .	2.25	0	Straw	137	126	131

[1/] All treatments received 70 lb. of phosphorus in fertilizer.

Table 44. Effects of Composted Garbage on Potassium Soil Test Values at 3 Dates After Application of Compost in June

Amendment		Annual rate of N lb./A	Mulch	Available soil potassium[1/] in lb./A		
Type	Volume in ft^3 per yd^2 of area			after 7 months	after 18 months	after 30 months
Compost	0.75	0	Straw	118	108	87
Compost	0.75	80	Straw	102	120	97
Compost	0.75	400	Straw	129	130	98
Compost	2.25	0	Straw	189	180	123
Compost	2.25	80	Straw	211	192	133
Compost	2.25	400	Straw	217	175	116
None	--	0	Straw	67	86	78
None	--	80	Straw	60	80	71
None	--	400	Straw	80	78	75
Compost	0.38	80	Compost	93	100	102
None	--	80	None	70	106	90
Compost	2.25	0	Straw	228	181	130

[1/] All treatments received 132 lb. of potassium in fertilizer.

Table 45. Effects of Composted Garbage on Soil pH Values at 3 Dates After Application of Amendments in June

Amendment		Annual rate of N		Soil test pH values		
Type	Volume in ft^3 per yd^2 of area	lb./A	Mulch	after 7 months	after 18 months	after 30 months
Compost . . .	0.75	0	Straw	7.3	7.2	7.1
Compost . . .	0.75	80	Straw	7.4	7.3	7.1
Compost . . .	0.75	400	Straw	7.4	7.2	7.0
Compost . . .	2.25	0	Straw	7.5	7.5	7.2
Compost . . .	2.25	80	Straw	7.5	7.5	7.3
Compost . . .	2.25	400	Straw	7.5	7.4	7.1
None	--	0	Straw	7.1	7.1	6.8
None	--	80	Straw	6.9	6.9	6.5
None	--	400	Straw	7.1	6.7	6.1
Compost . . .	0.38	80	Compost	6.9	7.1	6.8
None	--	80	None	6.7	6.7	6.6
Compost . . .	2.25	0	Straw	7.4	7.3	7.4

all plots as would be expected with a soluble cation under conditions favoring large leaching losses. Soil pH showed a continued decrease with the greatest decline on plots receiving the highest rates of nitrogen. At the last sampling date the effects of compost on pH were more apparent than at prior sampling dates. Plots receiving compost maintained the soil pH at 7.0 or above whereas with no compost the pH ranged from 6.1 to 6.8 depending on the rate of nitrogen applied during the 3-year period.

The general conclusions that can be drawn from the soils data are that the 0.75 ft^3 and 2.25 ft^3 rates of compost per yd^2 of soil surface incorporated into the soil increased pH and available soil phosphorus and potassium values for at least 30 months after application.

Growth and Foliar Analysis of Chrysanthemums Grown in Garbage Compost Amended Media

Most garbage compost materials contain considerable amounts of metals such as: calcium, magnesium, manganese, zinc, copper, iron, aluminum, sodium, boron, chromium, vanadium, arsenic, and molybdenum. Many of the heavy metals found in garbage compost are toxic to plants in minute quantities. Toxicity symptoms observed on plants may be the result of concentration of one or more of these elements in plant tissues. To investigate this possibility, foliar analysis experiments were conducted on chrysanthemums grown in garbage compost-amended soils.

Experiments compared original compost with Mobile Aid and other materials as a soil amendment for chrysanthemums. The two compost materials used had the following analyses:

Compost	Soluble salts(mhos)	pH	Elements (ppm Spurway)			
			N	P	K	Ca
Original . . .	30 - 86	8.4	0-5	0-1	20-40	100-150
Mobile Aid . . .	70 -195	8.5	0-2	0-1	20-40	100-300

Twelve potting mixtures were formulated from the two garbage composts, Table 46. The pH of the mixtures was adjusted to 6.0 using dolomitic limestone or fine sulfur. Gypsum was added to mixtures where the pH was adjusted with sulfur. Superphosphate was added to all mixtures at the rate of 1.6 kg per 1 m^3 of rooting media. Plants were fertilized every two weeks by watering with a solution containing 3 g of 25-10-10 fertilizer per liter of water.

Rooted cuttings of two cultivars of chrysanthemums (chrysanthemum morifolium Ramat.), 'Giant No. 4 Indianapolis White' and 'Giant No. 4 Indianapolis Yellow', were planted into two greenhouse benches containing 12 randomized plots each. Planting was done on June 5. The plants were pinched on June 19 and short day treatment was started on July 12.

Growth data consisted of the weight and length of the flowering stems cut at the pinch. Twenty flowering stems were selected at random for these determinations and measurement of flower diameters. Leaf samples were collected for chemical analysis approximately 4 weeks prior to flowering. Leaf samples were composed of the uppermost mature leaves (usually 7th or 8th leaf below the stem tips). A composite sample, representing each treatment, was prepared from the two cultivars. Spectrographic analyses for phosphorus, potassium, calcium, magnesium, sodium, zinc, manganese, iron, copper, boron, and aluminum; and micro-Kjedahl analysis for nitrogen were performed.

Most plants were in flower by September 11. Plants grown in media amended with either compost exhibited a marginal burn on their older leaves. Plants grown in peat-amended soils did not show any injury. Table 46 presents the growth data of the plants grown in the various media. The length of the flowering stem ranged from 84 cm (soil, perlite, and peat) to 65 cm (soil and Mobile Aid). Plants grown in peat-amended media (81 cm) averaged longer flowering stems than plants grown in original compost (78 cm) and Mobile Aid compost (73 cm) amended media.

Table 46. Growth Comparison of Cut Chrysanthemums Grown in Several Media

Media	Stem length cm	Stem weight g	Flower diameter cm
Soil and peat 1:1	81.0	90.4	13.0
Soil and original compost 1:1	71.1	70.5	12.2
Soil and Mobile Aid 1:1	65.0	62.0	11.9
Soil, peat and original compost 2:1:1	79.8	75.0	11.9
Soil, peat and Mobile Aid 2:1:1	78.0	72.5	12.4
Soil, perlite and peat 1:1:1	82.6	83.2	11.9
Soil, perlite and original compost 1:1:1	81.0	77.0	11.9
Soil, perlite and Mobile Aid 1:1:1	70.1	67.0	12.2
Soil, perlite, peat and original compost 2:2:1:1	80.0	80.8	12.2
Soil, perlite, peat and Mobile Aid 2:2:1:1	78.5	76.9	12.7

The mean weight of flowering stems of plants grown in peat-amended media (8.15 g) exceeded the mean stem weight of plants grown in media amended with original compost (75.8 g) and Mobile Aid compost (69.6 g). Plants grown in soil and Mobile Aid (62.0 g) had the smallest stem weight, and plants grown in soil and peat (90.4 g) had the largest stem weight.

Large differences in flower diameter were not apparent in plants grown in peat (12.2 cm), original compost (12.2 cm), and Mobile Aid (12.4 cm) amended media. Soil and peat (13.0 cm) produced the largest flowers. Most of the media yielded flower diameters approximately equal to the experiment mean (12.2 cm).

The foliar analysis of the plants is presented in Table 47. Plants grown in soil and original compost had the highest nitrogen level (5.20%). Kofranek* has stated that the critical nitrogen level for chrysanthemums is 4.5%. With the exception of plants grown in soil and original compost, all the plants had nitrogen levels below Kofranek's critical value. Phosphorus levels exceeded the optimum range in all plants. Plant potassium and calcium levels equalled or exceeded the optimum range in all media. Plants grown in soil and original compost (.22%), soil and Mobile Aid (.21%), peat, soil, and Mobile Aid (.31%), soil perlite, and Mobile Aid (.23%) and soil, perlite, peat, and Mobile Aid (.31%) had magnesium levels below the optimum but above the critical range. Soil and peat (.68%) and soil, perlite, and peat (.43%) exceeded the optimum range for magnesium. Sodium levels ranged from 770 ppm (soil, peat, and original compost) to 446 ppm (soil, peat, and Mobile Aid). Optimum and critical ranges were not available for sodium. Zinc levels were approximately 6 to 12 times the optimum range. It was not known if these zinc levels approached toxicity levels. Manganese reached a high of 1,116 ppm in soil, perlite, and compost. Toxicity from manganese has been observed in California at 800 ppm on the cultivars 'Good News' and 'Detroit News' and at 1,700 ppm on the cultivar 'Albatross'. The levels of iron were below the optimum range in all the plants;

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*Optimum and critical range supplied through courtesy of Dr. J. W. Boodley and are based on research conducted by Dr. J. W. Boodley of Cornell University and Dr. Anton Kofranek of the University of California at Davis.

Table 47. Foliar Analysis of Cut Chrysanthemum Grown in Peat-, Original Compost and Mobile Aid Compost Amended Media

Media	Per cent by weight					Concentration in ppm						
	N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B	Al
Soil and peat 1:1 ..	4.02	.88	5.43	1.94	.68	660	320	708	226	12	87	332
Soil and original compost 1:1	5.20	.62	6.60	2.02	.22	550	494	900	226	36	179	338
Soil and Mobile Aid 1:1 ...	4.04	.53	7.00	1.94	.21	510	402	826	194	28	236	290
Soil, peat and original compost 2:1:1 .	4.12	.69	6.20	2.36	.46	770	452	576	186	24	114	302
Soil, peat and Mobile Aid 2:1:1 .	4.04	.56	7.28	2.02	.31	446	384	396	146	29	157	236
Soil, perlite and peat 1:1:1	3.94	.84	6.60	1.80	.43	580	350	570	290	24	135	344
Soil, perlite and original compost 1:1:1 ..	3.58	.75	6.00	2.29	.38	610	558	773	202	34	129	308
Soil, perlite and Mobile Aid 1:1:1 ..	4.08	.71	6.60	1.83	.23	610	597	1116	210	34	230	320
Soil, perlite, peat, and original compost 2:2:1:1	3.94	.75	5.70	2.13	.40	490	294	564	170	22	113	228
Soil, perlite, peat and Mobile Aid 2:2:1:1	4.02	.65	6.94	1.98	.31	490	303	702	162	24	152	220
Optimum range[1]	5.0- 6.0	.27-40	4.5- 6.5	1.0- 2.0	.35- .65	?	20- 50	250- 500	500- 1000	25-75	50- 100-	?
Critical range	4.5	.20	3.5	0.5	.14	?		200	125	25	25	?

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[1] Optimum and critical range supplied through courtesy of Dr. J. W. Boodley and are based on research conducted by Dr. J. W. Boodley of Cornell University and Dr. Anton Kofranek of the University of California at Davis.

however, all the plants except those grown in soil and peat, had iron levels above the critical range. Copper levels were below the optimum and critical ranges in plants grown in soil and peat; soil, peat, and original compost; soil, perlite, and peat; soil perlite, peat, and original compost; and soil, perlite, peat, and Mobile Aid. Boron levels in the plants exceeded the optimum and critical ranges in all media. Indianapolis cultivars of chrysanthemum have been reported to be quite sensitive to boron toxicity (personal communication William J. Skou, Yoder Brothers, Barberton, Ohio). The aluminum content of the plants ranged from 106 ppm (soil and peat) to 382 ppm (soil, perlite, and peat). The status of aluminum in chrysanthemum nutrition has not been determined.

The above results showed the foliar analysis of 'Indianapolis' cultivars of chrysanthemums grown in media amended with composted garbage. High levels of boron, calcium, potassium, zinc, and manganese were observed in plants grown in soil amended with these composts. Although 'Indianapolis' cultivars are probably the most widely grown cut chrysanthemums, optimum and critical nutrient levels for chrysanthemums have been based in the main on two cultivars, 'Albatross' and 'Good News'. In addition, these cultivars differ in their optimum and critical levels for certain elements. To better access the nutrient status of cut chrysanthemums grown in media amended with compost, an experiment was conducted using the cultivars 'Albatross' and 'CF 2 Good News'.

Rooted cuttings of the two cultivars were planted in two greenhouse benches on July 29. The benches were divided into four replications consisting of six treatments per replication. The treatment plots were subdivided for cultivars. Treatments are given in Table 48. The pH of each media was adjusted to 6.0 using either dolomitic limestone or sulfur. Gypsum was added to the sulfur adjusted media at the rate of 0.8 kg per 1 m^3. Superphosphate was added to all the media at the rate of 1.6 kg per 1 m^3. Fertilization consisted of watering with a solution containing 200 ppm each of N, P, and K. The plants were pinched on August 12 and short day treatment was started on September 2.

Table 48. Foliar Analysis of Chrysanthemum cv. 'Albatross', Grown in Peat- and Mobile Aid Compost-Amended Media

Media	Per cent by weight					Concentration in ppm						
	N	P	K	Ca	Mg	Na	Z	Mn	Fe	Cu	B	Al
Soil and peat 1:1 .	5.52	.68	5.28	.78	.32	346	76	252	102	42	114	156
Soil and compost 1:1	4.96	.50	7.42	1.07	.17	1403	147	271	110	52	202	272
Soil, peat and compost 2:1:1....	4.87	.51	7.89	1.12	.16	572	109	264	100	48	171	197
Soil, perlite and peat 1:1:1	5.29	.70	6.24	1.00	.32	415	66	282	106	37	161	218
Soil, perlite and compost 1:1:1 ...	4.79	.51	7.49	1.13	.17	606	118	327	98	46	194	218
Soil, perlite, peat and compost 2:2:1:1 .	4.70	.53	7.95	1.13	.17	436	98	297	102	44	159	199
Mean	5.02	.57	7.05	1.04	.22	629	102	279	103	45	167	210
Optimum range[1]..	5.0-6.0	.21-.40	4.5-6.5	1.0-2.0	.35-.65	?	20-50	250-500	500-1000	25-75	50-100	? ?
Critical range	4.5	.20	3.5	0.5		?	?	200	125	25	25	?

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[1] Optimum and critical ranges supplied through the courtesy of Dr. J. W. Boodley of Cornell University and are based on research conducted by Dr. J. W. Boodley of Cornell University and Dr. Anton Kofranek of the University of California at Davis.

Leaf samples were collected from the two cultivars on September 9. The uppermost mature leaves (usually the 7th or 8th leaf, below the stem tip) were collected. The leaves were rinsed twice in distilled water and stored in bags in a refrigerator until drying in an oven at 80°C. The dried samples were ground with a Wiley mill using a 20-mesh screen and analyzed for nitrogen, phosphorus, potassium, calcium, magnesium, sodium, zinc, manganese, iron, copper, boron, and aluminum.

Plants grown in compost-amended media generally contained more potassium, calcium, sodium, zinc, and boron than plants grown in peat-amended media, Tables 48 and 49. The levels of nitrogen, phosphorus and magnesium were higher in plants grown in media containing peat than in compost amended media. The nitrogen content of both cultivars exceeded the critical range; however, some plants did not have a nitrogen content in the optimum range. The highest nitrogen content was observed with 'Albatross' grown in soil and peat. The lowest nitrogen content was found where 'CF 2 Good News' was grown in soil, peat, and compost mixture. 'Albatross' averaged slightly higher nitrogen levels than 'CF 2 Good News'.

Table 49. Foliar Analysis of Chrysanthemum, cv. 'CF 2 Good News', Grown in Peat- and Mobile Aid Compost-Amended Media

Media	Per cent by weight					Concentration in ppm						
	N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B	Al
Soil and peat 1:1.	5.37	.75	6.15	1.21	.53	306	58	341	100	37	105	181
Soil and compost 1:1..........	4.65	.54	8.49	1.56	.29	282	100	365	86	55	179	209
Soil, peat and compost 2:1:1.....	4.53	.61	8.11	1.65	.32	272	87	315	94	43	155	222
Soil, perlite and peat 1:1:1......	5.28	.78	6.27	1.38	.51	294	57	362	103	33	109	200
Soil, perlite and compost 1:1:1...	4.80	.58	8.15	1.53	.30	276	96	356	81	41	157	193
Soil, perlite, peat and compost 2:2:1:1.	4.66	.63	8.25	1.58	.31	292	97	380	90	39	153	234
Mean..............	4.88	.65	7.57	1.49	.38	287	83	353	92	41	143	206
Optimum range[1]..	5.0-6.0	.27-.40	4.5-6.5	1.0-2.0	.35-.65	?	20-50	250-500	500-1000	25-75	50-100-	?
Critical range....	4.5	.20	3.5	0.5	.14	?	?	200	125	25	25	?

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[1] Optimum and critical ranges supplied through the courtesy of Dr. J. W. Boodley of Cornell University and are based on research conducted by Dr. J. W. Boodley of Cornell University and Dr. Anton Kofranek of the University of California at Davis.

Phosphorus was above the optimum levels for both cultivars in all treatments. Plants of 'CF 2 Good News' grown in soil, perlite, and peat had the highest phosphorus content; whereas, 'Albatross' grown in soil and compost had the lowest phosphorus content. 'CF 2 Good News' averaged slightly higher phosphorus levels than 'Albatross'.

Potassium levels were optimum in all treatment combinations. Some treatment combinations had potassium levels greater than twice the critical level. The highest potassium content was observed with 'CF 2 Good News' grown in soil and compost, and the lowest potassium content was observed with 'Albatross' grown in soil and peat. Generally, 'CF 2 Good News' plants contained more potassium than 'Albatross' plants.

All treatments had magnesium levels below the optimum range but above the critical level. With the exception of plants grown in soil and peat; and soil, perlite and peat; all treatments for 'CF 2 Good News' had magnesium levels below the optimum range but exceeding the critical level. The highest magnesium levels occurred when 'CF 2 Good News' was grown in soil and peat. The lowest magnesium content was observed with 'Albatross' grown in soil, peat, and compost.

No optimum or critical levels for sodium are available for chrysanthemums. 'Albatross', grown in soil and compost had the highest sodium levels. Lowest sodium content occurred with 'CF 2 Good News' grown in soil, peat, and compost. The average sodium content of 'Albatross' was more than twice that of 'CF 2 Good News'.

In all treatments, the two cultivars exceeded the optimum levels for zinc. 'Albatross', grown in soil and compost, had the highest zinc content of any treatment; whereas, 'CF 2 Good News', grown in soil, perlite, and peat had the lowest zinc content of any media.

All plants had iron levels below the critical level. The highest iron level occurred with 'Albatross' grown in soil, perlite, and peat; whereas, the lowest concentration occurred with 'CF 2 Good News' grown in soil, perlite, and garbage.

Levels for copper were optimum for both cultivars in all treatments. 'CF 2 Good News' plants grown in soil and garbage had the highest copper concentration of the experiment. The lowest copper content occurred with 'CF 2 Good News' grown in soil, perlite and peat. The two cultivars differed in copper content with 'Albatross' containing more copper than 'CF 2 Good News'.

Plants in all treatments had boron levels exceeding the optimum range. The concentration of boron in 'Albatross' grown in soil and compost was over twice the optimum amount - the highest in the experiment. The lowest boron level in the experiment occurred with 'CF 2 Good News' grown in soil and peat.

Optimum and critical levels for aluminum in chrysanthemum are unknown. 'Albatross' grown in soil and compost had the highest aluminum concentration. The lowest aluminum concentration occurred with 'Albatross' grown in soil and peat.

Effect of Various Media Combinations of Peat and Original Compost on the Growth of Potted Chrysanthemums, cv. 'Golden Yellow Princess Anne'

Most growers of potted chrysanthemums have a particular media which they use in the production of their plants. Such media are usually combinations of soil, organic, and inorganic amendments. Peat moss is the most commonly used organic amendment and often constitutes 25 to 50 per cent of the media by volume. Inorganic amendments are numerous but sand, perlite, vermiculite, calcined clay, and slag are frequently used. Compost might be used as a substitute for peat moss; however, the best inorganic amendments to use with garbage compost might be quite different from the best inorganic amendment often combined with peat moss. Furthermore, if garbage compost does contain some toxic substance, certain inorganic amendments might absorb these substances. The leaf injury observed on some plants might be eliminated by this absorption, Fig. 19. Experiments were designed to determine the effects of various media combinations of peat, slag, calcined clay and original compost on the growth of potted chrysanthemums. Treatments are given in Table 50.

Table 50. Effect of Various Media Combinations of Peat and Original Compost on the Height and Number of Flowers Per Plant of Potted Chrysanthemums, cv. 'Golden Yellow Princess Anne'

Media combination	Height	Number of flowers per plant
	cm	
Soil and peat 1:1	28	2.9
Soil and compost 1:1	30	3.8
Soil, peat and compost 2:1:1	30	3.6
Soil, perlite and peat 1:1:1	32	3.1
Soil, perlite and compost 1:1:1	35	3.8
Soil, perlite, peat and compost 2:2:1:1	31	3.4
Soil, calcined clay and peat 1:1:1	32	3.2
Soil, calcined clay and compost 1:1:1	31	3.9
Soil, calcined clay, peat and compost 2:2:1:1	29	3.6
Soil, foundry slag and peat 1:1:1	30	3.6
Soil, foundry slag and compost 1:1:1	31	3.7
Soil, foundry slag, peat and compost 2:2:1:1	29	3.8

The pH of each media was adjusted as previously shown. Fertilization consisted of 4.7 kg of 12-6-6 per 1 m^3 of media incorporated prior to planting and watering with a solution containing 200 ppm N, 80 ppm P, and 80 K. There were five rooted cuttings of cv. 'Golden Yellow Princess Anne' chrysanthemums (Chrysanthemum morifolium Ramat.) in each pot and five pots in each treatment. Three weeks after the start of short days, the plants were sprayed with a hormone to reduce excessive elongation. Plants were grown in a greenhouse at a night temperature of 17°C. The first planting was made on November 15 followed by the other three plantings at 2 week intervals. The last planting flowered on March 19.

The mean height of plants and the average number of flowers per plant were similar for all treatments, Table 50.

Influence of Peat- and Mobile Aid Compost-Amended Media on the Growth of Potted Chrysanthemum, cv. 'Yellow Mandalay'

Mobile Aid compost was compared to imported German peat moss as an organic soil amendment in production of potted chrysanthemums, (*chrysanthemum morifolium* Ramat.), cv. 'Yellow Mandalay'. Five rooted cuttings were transplanted per 15 cm pot using potting mixtures shown in Table 51. The pH of each soil mixture was adjusted to 6.0 using limestone or sulfur as needed. Gypsum, as a source of calcium was added at the rate of 1.2 kg per 1 m^3 and 12-6-6 fertilizer at the rate of 4.7 kg per 1 m^3 of media. After potting, all plants were fertilized at each watering with a solution containing 200 ppm nitrogen, 80 ppm phosphorus, and 80 ppm potassium.

Records on the height and number of flowers per plant were taken at flowering on 40 plants per treatment.

A mixture of soil, perlite, and peat produced the tallest plants (28.4 cm), Table 51. The shortest plants were produced in soil, perlite, and Mobile Aid (19.3 cm). Mixtures amended with peat moss produced a greater mean height (25.1 cm) than mixtures amended with processed garbage (20.0 cm), (Fig. 20).

The greatest mean number of flowers per plant was produced by plants grown in soil and Mobile Aid (4.2). Plants grown in soil, perlite and peat, and soil and peat had the fewest flowers per plant (3.3 and 3.4, respectively). Plants grown in Mobile Aid amended soil (4.0) produced more flowers per plant than those grown in peat amended soil (3.4), Fig. 20.

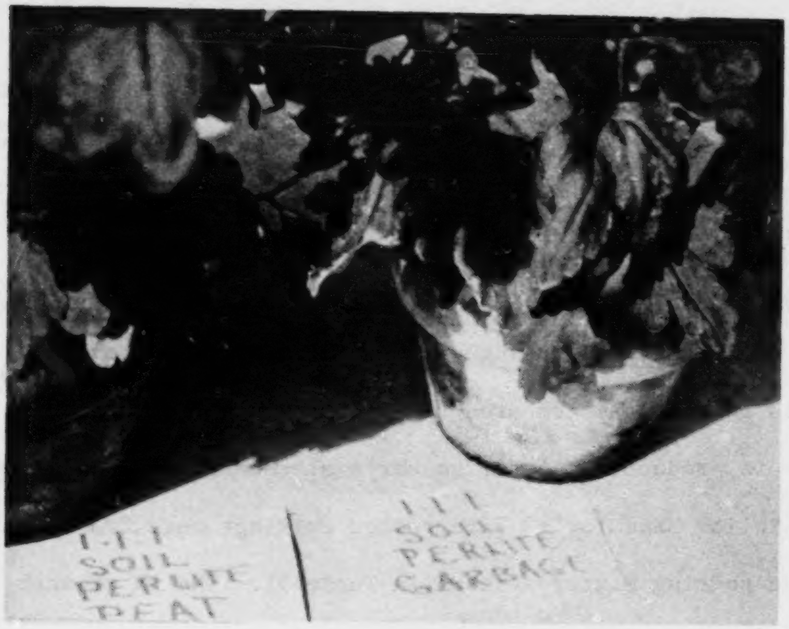
1-1-1
SOIL
PERLITE
PEAT
1-1-1
SOIL
PERLITE
GARBAGE

Fig. 19. Typical marginal scorch and necrotic spots on chrysanthemum leaves when grown in garbage compost amended media.

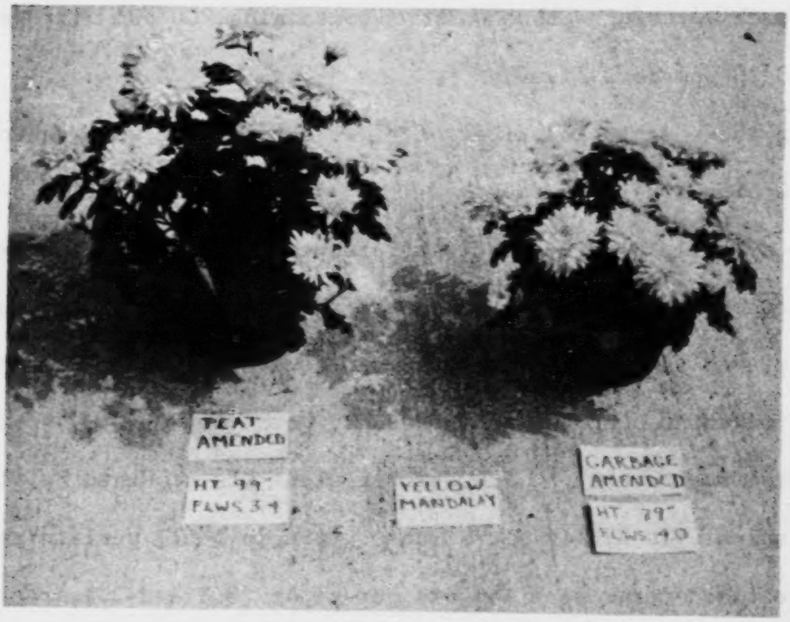
PEAT
AMENDED
HT 9.9"
FLWS 3.4
YELLOW
MANDALAY
GARBAGE
AMENDED
HT 7.9"
FLWS 4.0

Fig. 20. Taller chrysanthemums and fewer flowers on peat amended than on Mobile Aid amended media.

Table 51. Influence of Peat- and Mobile Aid Compost-Amended Media on the Growth of Potted Chrysanthemums, cv. 'Yellow Mandalay'

Media	Height above pot rim	Number of flowers per plant
	cm	
Soil and peat 1:1	21.8	3.4
Soil and Mobile Aid 1:1	20.6	4.2
Soil, peat and Mobile Aid 2:1:1	23.6	3.9
Soil, perlite and peat 1:1:1	28.4	3.3
Soil, perlite and Mobile Aid 1:1:1	19.3	3.8
Soil, perlite, peat and Mobile Aid 2:1:1:2	25.4	3.7

The overall appearance of all plants was satisfactory. Plants grown in Mobile Aid-amended media did not exhibit the pronounced lower leaf injury often observed in experiments with original compost.

Influence of Soil Mixtures Amended with Recomposted Mobile-Aid Compost on the Growth of Chrysanthemums, cv. 'Yellow Mandalay'

Mobile Aid compost that had been recomposted was used as a soil amendment in the production of three crops of potted chrysanthemums, cv. 'Yellow Mandalay'. Table 52 presents the 18 mixtures. Five cuttings were placed in a 15 cm pot for each treatment.

A constant fertility program by watering with a solution of 200 ppm nitrogen, 80 ppm phosphorus, and 80 ppm potassium was used. An appropriate photoperiod control program was developed for each experiment to produce a flowering plant. Plants were grown in a lightly shaded greenhouse and at a night temperature of 16°C. The first crop was planted on July 24, the second on August 7 and the third on August 21.

Growth of all plants was normal. The foliar burn previously observed on the leaf margin of plants grown in compost amended media was not evident in

Table 52. Height and Number of Flowers Produced by Chrysanthemum, cv. 'Yellow Mandalay', Grown in 1:1 Mixtures of Soil and Mobile Aid Compost

1:1 Soil-Compost mixture[1/]	Height cm	Number of flowers per plant
Mobile Aid recomposted with 1.6 kg 8-8-8 fertilizer per 1 m^3 plus -		
0.4 kg Sulfur	31.2	5.5
2.4 kg $AlSO_4$	31.5	5.6
2.4 kg $FeSO_4$	31.2	5.3
2.4 kg $MgSO_4$	31.2	5.4
2.4 kg NH_4SO_4	30.7	5.8
0.8 kg Lime-Sulfur	31.8	5.7
0.8 kg $CaSO_4$	30.0	5.5
Mobile Aid recomposted with 1.6 kg NH_4SO_4, 0.8 kg $Ca(H_2PO_4$, 0.4 kg KCl, 0.1 kg $MgSO_4$ and 0.1 kg NaCl per 1 m^3 plus -		
0.8 kg $CaMg(CO_3)_2$	31.0	6.0
0.4 kg Sulfur	31.0	5.4
2.4 kg $AlSO_4$	30.5	6.0
2.4 kg $FeSO_4$	30.2	6.0
2.4 kg $MgSO_4$	30.0	6.0
2.4 kg NH_4SO_4	31.0	5.6
0.8 kg Lime-Sulfur	30.5	5.5
0.8 kg $CaSO_4$	29.5	5.9
Mobile Aid recomposted with no additions at composting		
Check	31.0	5.8
Check plus 0.8 kg $CaSO_4$, 1.6 kg 8-8-8, and 0.4 kg Sulfur per 1 m^3	29.7	6.1
Soil and Peat plus		
1.6 kg 8-8-8, 4.7 kg $CaMg(CO_3)_2$, and 1.9 kg $Ca(HPO_4)_2$ per 1 m^3	28.7	5.2

[1/] Mobile Aid was recomposted by moistening and mixing every 2 weeks for 12 weeks.

these experiments. The soluble salts level was considerably lower in recomposted than in unrecomposted Mobile Aid and this might explain the absence of the injury.

The greatest differences between treatments occurred in the number of flowers per plant, Table 52. Soil and peat moss plus additives had the least number of flowers per plant (5.2). Plants grown in a mixture of recomposted Mobile Aid and soil with $CaSO_4$, 8-8-8 fertilizer and sulfur added at potting produced the most flowers per plant (6.1). Several other treatments produced as many as 6.0 flowers per plant. The addition of 8-8-8 fertilizer at composting averaged 5.5 flowers per plant when mixed with soil and used as a growth medium. Plants grown in 1:1 mixture of soil and Mobile Aid which had been recomposted with NH_4SO_4, $Ca(H_2PO_4)_2$, KCl, $MgSO_4$ and NaCl averaged 5.8 flowers per plant. This recomposted compost combination had a higher nitrate level than those receiving 8-8-8. The addition of either $AlSO_4$, $FeSO_4$ or $CaMg(CO_3)_2$ to the former increased the number of flowers per plant to 6.0.

Comparison of Three Compost Products as Soil Amendments on the Growth of Potted Chrysanthemums, cv. 'Yellow Mandalay'

Three commercial compost products, Mobile Aid, Cura, and Cofuna, were evaluated as soil amendments in experiments on the growth of chrysanthemum, cv. 'Yellow Mandalay'. Cura is a fortified municipal compost supplied by the International Disposal Corporation, St. Petersburg, Florida. According to the listed analysis, Cura contains 10,000 ppm nitrogen, 20,000 ppm phosphorus, and 10,000 ppm potassium. Because of the extremely high readings, a reliable Spurway analysis could not be obtained. The material has a pH of 5.6 and a soluble salt reading of 1,000 mhos. Cofuna is the trademark of the French

Natural Hymus Company, Paris, France for a humic and biological fertilizer. Cofuna is a vegetal waste by-product. Spurway analysis of Cofuna revealed 600-700 ppm nitrates, 50-75 ppm phosphorus, 200-250 ppm potassium and 200-400 ppm calcium. The pH was 5.4 and soluble salts read 250 mhos.

Six media were made from these amendments. The various media and the results of Spurway analysis prior to adjustment are presented in Table 53. All media received 1.6 kg superphosphate per 1 m^3. The pH except for mixtures containing Mobile Aid was adjusted to 6.5 with dolomitic limestone. Mobile Aid media received no pH adjustment. Gypsum was added to all media except Mobile Aid media at the rate of 1.4 kg per 1 m^3. Mobile Aid media received 2.8 kg gypsum per 1 m^3. All plants were fertilized at each watering throughout their growth with a solution containing 200 ppm nitrogen, 80 ppm phosphorus, and 80 ppm potassium.

Five cuttings of chrysanthemums cv. 'Yellow Mandalay', were potted in 15 cm pots with five pots being used per media. A single spray of a growth retardant was applied to the plant 2 weeks after pinching in each crop. Data in Table 54 are averages of three plantings. Soluble salt injury was noted early in the growth of plants grown in Cura media. Root damage was evident and the top of the plant was chlorotic. The plants recovered from this injury in a few weeks following repeated watering.

The height of the plants ranged from 52.1 cm (soil and Mobile Aid) to 45.7 cm (soil and peat). The addition of Cofuna increased the height of the plants in all media except Mobile Aid and soil.

Soil and Mobile Aid (5.7) and soil, Mobile Aid, and Cofuna (5.6) produced the most number of flowers per plant, Table 54. Soil and peat had the least number of flowers per plant (4.7). The addition of Cofuna increased the number of flowers produced by plants grown in soil and peat, decreased the flower number of plants grown in soil and Mobile Aid and had no effect on the flower number of plants grown in soil and Cura.

Table 53. Spurway Analysis, pH and Soluble Salts Reading (1:5) of Media Amended with Various Composts

Media	Spurway analysis (ppm)				pH	Soluble salts (mhos)
	NO_3	P	K	Ca		
Soil and peat 1:1	2	5	10-20	20	4.0	48
Soil, peat and Cofuna 5:4:1. . . .	25-50	5-10	20	50	4.3	55
Soil and Mobile Aid 1:1 .	25-50	2-5	20	200	6.9	48
Soil, Mobile Aid and Cofuna 5:4:1	25-50	5	20	150	6.6	65
Soil and Cura 1:1 . .	150 +	5	60-80	200	5.7	1000
Soil, Cura and Cofuna 5:4:1 . . .	150 +	5-10	60-80	200	5.7	800

Table 54. Comparison of Three Compost Products as Soil Amendments on the Growth of Potted Chrysanthemum, cv. 'Yellow Mandalay'

Media	Height cm	Number of flowers per plant
Soil and peat 1:1	45.7	4.7
Soil, peat and Cofuna 5:4:1	49.5	5.1
Soil and Mobile Aid 1:1	52.1	5.7
Soil, Mobile Aid and Cofuna 5:4:1	50.3	5.6
Soil and Cura 1:1	44.5	5.1

Effect of Media Containing Original Compost on the Growth of Chrysanthemum, cv. 'Sunstar'

Potted chrysanthemums grown in media amended with original compost often showed an injury on lower leaves while producing more flowers per plant than plants grown without compost. The amount of compost used in the media of these experiments ranged from 33 to 50 per cent. The injury might be reduced or eliminated by using smaller amounts of compost in the media; however, a similar reduction in flower number might also be obtained. It was hoped that the trend of increased flower number would be unaffected by a reduction in the amount of compost in the media. Three experiments were conducted to determine the influence of media containing various amounts of original compost on the growth of chrysanthemum (chrysanthemum morifolium Ramat.), cv. 'Sunstar'.

The six media treatments are given in Table 55. The pH of each media was adjusted to 6.5 according to lime requirement test. Dolomitic limestone or sulfur was used for adjustment. Media not adjusted with limestone received 0.8 kg of gypsum per 1 m^3. All media received 1.6 kg of superphosphate per 1 m^3. Ten 15 cm pots of each media were used in each experiment. Five ml of 14-14-14 fertilizer was added to each 15 cm pot just prior to planting. Five rooted cuttings were planted per pot. Plants were also fertilized at each watering with a solution containing 200 ppm each of nitrogen, phosphorus and potassium. The experiments were conducted in a greenhouse with an appropriate photoperiod, pinching, and disbudding schedules.

Data on the height of the plant above the pot rim and the number of flowers per plant were recorded at flowering. Leaf samples were collected within 2 weeks of the start of short days in each experiment. The 7th or 8th leaf from the stem tip was sampled. A composite sample was prepared from the leaves of the three experiments for foliar analysis.

The mean height of plants grown in equal amounts of soil and compost was more than 3 cm less than the mean height of plants grown in soil and peat, Table 55. Media amended with 10 to 40 per cent compost produced some of the tallest plants in the experiment. The addition of 20 per cent or more compost to the media increased the number of flowers per plant. The most flowers per plant were produced in 5:2:3 soil, peat, and compost media. Media containing more than 30 per cent compost resulted in a slight reduction in flower number.

Table 55. Height and Number of Flowers Per Plant of Chrysanthemum, cv. 'Sunstar' Grown in Media Containing Various Amounts of Original Compost

Media	Height cm	Number flowers per plant
Soil and peat 1:1	35.8	4.0
Soil, peat and compost 5:4:1	36.6	4.0
Soil, peat and compost 5:3:2	37.1	4.1
Soil, peat and compost 5:2:3	37.1	4.5
Soil, peat and compost 5:1:4	36.6	4.3
Soil and compost 1:1	33.0	4.2

Table 56 presents the foliar analysis of the composite samples. Most of the media produced plants with elements in the optimum range unless otherwise indicated. Nitrogen was below the critical range in plants grown in all compost amended media except soil, peat, and compost 5:3:2. The highest nitrogen content occurred in plants grown in soil and peat 1:1 and soil, peat, and compost 5:3:2. Plants grown in soil and peat 1:1 and soil and compost 1:1 contained the most and least amount of phosphorus, respectively. The potassium content of the plants was highest in soil, peat, and compost 5:4:1 and lowest in soil and peat 1:1. Media containing more than 10 per cent compost produced plants with critical or near critical magnesium levels. Plants grown in soil and peat 1:1 contained the most magnesium. Sodium was 50 to 100 ppm higher in plants grown in compost amended media than in soil and peat 1:1. Plants grown in media containing 10 to 50 per cent compost had two to five times as much zinc as plants grown in soil and peat 1:1. None of the media yeilded plants

Table 56. Foliar Analysis of Chrysanthemum, cv. 'Sunstar' Grown in Media Containing Various Amounts of Original Compost

	Elements											
	% by Weight					Concentration in ppm						
Media	N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B	Al
Soil and peat 1:1	4.60	1.25	4.97	2.02	.77	1140	67	216	130	17	57	278
Soil, peat & compost 5:4:1 ...	4.32	1.10	5.80	2.16	.60	1200	122	288	130	19	53	344
Soil, peat & compost 5:3:2 ...	4.60	.98	5.18	2.29	.34	1090	197	390	122	18	67	220
Soil, peat & compost 5:2:3 ...	4.02	.91	5.22	2.50	.35	1170	208	366	146	18	63	382
Soil, peat & compost 5:1:4 ...	4.00	.90	5.20	2.74	.33	1240	254	486	130	20	76	208
Soil & compost 1:1 ...	4.15	.72	5.60	3.15	.35	1200	320	390	146	23	76	450
Mean	4.28	.98	5.33	2.48	.46	1173	195	356	134	19	65	314
Optimum range[1/]	5.0-6.0	.27-.40	4.5-6.5	1.0-2.0	.35-.65	?	20-50	250-500	500-1000	25-15	50-100	?
Critical range	4.5	.20	3.5	0.5	.14	?	?	200	125	25	25	?

[1/] Optimum and critical ranges are supplied through the courtesy of Dr. J. W. Boodley of Cornell University and are based on research conducted by Dr. J. W. Boodley of Cornell University and Dr. Aton Kofranek of the University of California at Davis.

with iron in the optimum range. The copper content of the plants from all media was below the critical range. Plants grown in soil and peat 1:1, and soil and compost 1:1 had the lowest and highest copper content, respectively.

Influence of Peat- and Original Compost-Amended Media on the Growth of Easter Lilies

Easter Lilies (Lilium longiflorium Thumb.), a crop which is usually grown at a high pH, were grown in various soil mixtures amended with compost. Precooled bulbs of Easter lilies, cv. 'Nellie White' and cv. 'Ace' were potted on January 2 in the 12 soil mixtures shown in Table 57. The pH of each mixture was adjusted to 6.5 as shown above for chrysanthemums. Mixtures adjusted with sulfur (soil and compost; soil, perlite, and compost; soil, compost, and foundry slag; and soil, compost, peat, and foundry slag) were amended with gypsum at the rate of 0.8 kg per 1 m^3. Fertilization consisted of 4.7 kg of 12-6-6 fertilizer per 1 m^3 of media plus watering with a solution containing 200 ppm nitrogen, 80 ppm phosphorus and 80 ppm potassium. A Spurway analysis of the mixtures was taken one month after potting and revealed that nitrates were 5-25 ppm for all mixtures except soil, perlite, and peat (2 ppm). In all mixtures the phosphorus levels were 5 ppm and potassium ranged from 5 to 10 ppm. Calcium was 100 ppm or above except in soil and peat, and soil, perlite, and peat. Two months after potting, nitrates were low (0-10 ppm) in all mixtures except soil and peat, and soil, peat, compost, and foundry slag. Phosphorus had dropped to 2 ppm in soil, perlite and compost; and soil, compost, and foundry slag. Potassium was adequate (25 ppm) in soil and compost; soil, perlite, and peat; and soil, compost, and foundry slag. Calcium was adequate (100-150 ppm) in soil and compost; soil, perlite, and compost; and soil, compost, and foundry slag. Following each soil test the fertility was adjusted to a range considered adequate.

Fifteen pots of each of the cultivars were used in the 12 media treatments. The heights and numbers of flowers per plant were determined on the first 10 plants to flower.

Soil media was found to influence plant height, Table 57. The greatest mean height (41.9 cm) was produced when the lilies were grown in soil and compost. The shortest mean heights were produced by plants grown in soil, calcined clay, peat, and compost (33.9 cm), and soil, calcined clay, and compost (34.0 cm). 'Ace' produced the tallest plants when grown in soil and compost (50.5 cm) and the shortest plants when grown in soil, calcined clay, peat, and compost (35.3 cm). The tallest and shortest plants for 'Nellie White' were grown in soil and peat (34.8 cm) and soil, calcined clay, and compost (30.0 cm), respectively. Considering the various media combinations, soil and either or both of the organic materials (38.8 cm) and soil, perlite and peat, compost or both (38.9 cm) produced the tallest plants. The combination of soil, calcined clay, and organic amendment produced the shortest plants (35.4 cm); however, soil, foundry slag, and organic amendment averaged approximately the same height (36.0 cm). Media containing peat produced lilies with a mean height of 33.5 cm and media containing compost produced lilies with a mean height of 30.0 cm.

Table 57. Influence of Peat- and Original Compost-Amended Media on the Mean Height of 'Ace' and 'Nellie White' Easter Lilies

Media	'Ace'	'Nellie White'	Mean
	cm	cm	cm
Soil and peat 1:1	43.0	34.8	38.9
Soil and compost 1:1	50.5	33.3	41.9
Soil, peat, and compost 2:1:1	39.5	31.5	35.5
Soil, perlite, and peat 1:1:1	45.0	31.8	38.4
Soil, perlite, and compost 1:1:1	48.3	31.3	39.8
Soil, perlite, peat, and compost 2:2:1:1	44.0	32.8	38.4
Soil, calcined clay, and peat 1:1:1	43.8	33.0	38.4
Soil, calcined clay, and compost 1:1:1	38.0	30.0	34.0
Soil, calcined clay, peat, and compost 2:2:1:1	35.3	32.5	33.9
Soil, foundry slag, and peat 1:1:1	41.3	33.3	37.3
Soil, foundry slag, and compost 1:1:1	37.8	33.3	35.6
Soil, foundry slag, peat, and compost 2:2:1:1	37.6	32.5	35.1

The mean number of flowers per plant ranged from 6.0 ('Ace' grown in soil, perlite, and compost) to 3.3 ('Nellie White' grown in soil, foundry slag, and peat; and soil, calcined clay, and compost). Table 58. 'Ace' lilies produced the most flowers when grown in soil, perlite, and compost (6.0) and the fewest flowers when grown in soil, foundry slag, and compost (3.5). Flower number was greatest for 'Nellie White' in soil and peat (4.3), and soil, calcined clay, and peat (4.3). 'Ace' (5.1) averaged more flowers per plant than 'Nellie White' (3.9). Considering media, the highest mean number of flowers occurred where plants were grown in soil, calcined clay, and peat (5.3). Soil, foundry slag, and compost yielded the fewest flowers per plant (3.5).

Table 58. Influence of Peat- and Original Compost-Amended Media on the Mean Number of Flowers per Plant of 'Ace' and 'Nellie White' Easter Lilies

Media	'Ace'	'Nellie White'	Mean
Soil and peat 1:1	5.1	4.3	4.7
Soil and compost 1:1	5.8	4.1	5.0
Soil, peat and compost 2:1:1	4.9	4.0	4.5
Soil, perlite and peat 1:1:1	4.6	4.0	4.3
Soil, perlite and compost 1:1:1	6.0	4.1	5.1
Soil, perlite, peat and compost 2:2:1:1	5.7	4.0	4.9
Soil, calcined clay and peat 1:1:1	6.2	4.3	5.3
Soil, calcined clay and compost 1:1:1	5.3	3.3	4.3
Soil, calcined clay, peat and compost 2:3:1:1 .	4.4	4.1	4.3
Soil, foundry slag and peat 1:1:1	5.5	3.3	4.4
Soil, foundry slag and compost 1:1:1	3.5	3.4	3.5
Soil, foundry slag, peat and compost 2:2:1:1 .	4.2	3.4	3.8

Influence of Peat and Original Compost-Amended Media and Constant Fertilization with and without a Single Application of Iron Chelate on the Growth of Geraniums

Rooted, cultured cuttings of the geranium (*Pelargonium hortorum* Bailey) cultivars 'Blaze', 'Dark Red Irene', 'Eleanor', and 'Summer Cloud' were potted on April 24 with mixtures as shown in Table 59: (1) soil and peat 1:1; (2) soil and compost 1:1; (3) soil, peat, and compost 2:1:1; (4) soil, perlite, and peat 1:1:1; (5) soil, perlite, and compost 1:1:1; (6) soil, perlite, peat, and compost 2:2:1:1. The pH of the mixtures was adjusted to 6.0 and fertilizer applied as shown previously for Easter lilies. Iron chelate at the rate of 1.5 mg per 1 l of solution was added once to the water applied to one-half the pots in each treatment. Plants were grown one plant per 15 cm pot and each treatment contained four pots. The greenhouse was lightly shaded and cooled to 21°C during the day. On July 10 the dry weight was determined on two of the plants in each treatment.

Plant dry weight was greatest when the plants were grown in either soil, perlite, and peat or soil, perlite, peat, and compost, Table 59. Plants grown in soil and compost yielded the least dry weight (15.7 g). Considering the organic amendments, plants grown in peat-amended soils (20.9 g) produced more dry weight than plants grown in compost-amended soil (16.6 g). 'Eleanor' had the greatest plant dry weight (23.5 g) and 'Dark Red Irene' had the least (13.5 g). The single application of iron chelate increased the plant dry weight of geraniums in all media. Plants which received iron chelate averaged 19.6 g whereas plants which did not receive chelate had a mean of 18.2 g. It

Table 59. Influence of Peat- and Original Compost-Amended Media on the Mean Dry Weight of Four Geranium Cultivars

	Cultivars				
Media	'Blaze'	'Dark Red Irene'	'Eleanor'	'White Cloud'	Mean
	g	g	g	g	g
Soil and peat 1:1.	19.0	14.8	26.5	21.2	20.4
Soil and compost 1:1	14.5	11.2	20.9	16.3	15.7
Soil, peat and compost 2:1:1 ..	17.3	14.5	19.8	18.1	17.4
Soil, perlite and peat 1:1:1 ..	21.5	16.4	26.0	21.1	21.3
Soil, perlite and compost 1:1:1.	17.3	11.2	22.1	19.4	17.5
Soil, perlite, peat and compost 2:2:1:1.......	20.8	12.9	27.5	23.9	21.3

was not determined whether the effect of the chelate was a result of the application of iron, a reduction in pH, or both. Symptoms of iron chlorosis had been observed in preliminary tests on other plants.

Influence of Peat- and Original Compost-Amended Media on the Growth of Gloxinia

Seedlings of Gloxinias (Sinningia speciosa Benth. and Hook.) cv. 'Panzer Scarlet' and cv. 'Missle Series' were transplanted into 13 cm pots on March 1. Two soil mixtures were used in transplanting: soil and peat 1:1, and soil and original compost 1:1. Each treatment was composed of 25 pots of each cultivar. The pH of the mixtures was adjusted to 6.0 using dolomitic limestone on the peat-amended media and sulfur on the compost-amended media. Gypsum was added to the compost-amended media at the rate of 1.4 kg per 1 m^3. Superphosphate was added to the two media at the rate of 1.6 kg per 1 m^3. Plants were fertilized every 2 weeks with 25-10-10 fertilizer at the rate of 3.1 g per liter of water. Plants were grown in a shaded greenhouse.

Observations were made on the growth of the plants. The dry weight of 10 plants of each cultivar in each treatment was taken at flowering.

Plants of both cultivars flowered earlier when grown in the soil and compost mixture than when grown in the soil and peat mixture. Most flowering occurred early in July; however, some of the compost-grown plants flowered in late June. The foliage of plants grown in the soil and compost mixture was a lighter green than the foliage of peat-grown plants. The two most striking differences between plants grown in the two mixtures were leaf shape and size, Fig. 21. Peat-grown plants had the normal oblong-ovate leaf shape; whereas, the leaves of compost-grown plants were oblong, almost strap-like or nearly oblanceolate. The leaves of plants grown in soil and peat were approximately 30 to 40% larger (mostly in width) than the leaves of compost-grown plants.

Influence of Peat- and Original Compost-Amended Media on the Growth of Two Flowering Groups of Snapdragons

Two crops of snapdragons (*Antirrhinum majus* L.) were grown to study the influence of peat and compost on their growth. The first crop consisted of snapdragons belonging to the flowering response Group II which is recommended for winter flowering in the South. Seedlings of the cultivars 'Jackpot', 'Twenty Grand', and 'Sakata No. 148' were benched on January 18. The second crop consisted of snapdragons belonging to the flowering response Group IV which is recommended for summer flowering in the South. Seedlings of the cultivars 'Potomac White' and 'Potomac Pink' were benched on March 7. A spacing of 10 x 10 cm was used on both crops. All plants were grown single stem. The seedlings were transplanted into six media as shown in Table 60. The pH of the media was adjusted to 6.0. Fertilization consisted of bimonthly watering with a solution containing 3 g of 25-10-10 fertilizer per liter of water.

At flowering, 20 plants from each media were cut at the soil line; and from these samples, plant height, plant weight, and flower head or spike length were determined. Five plants from each media were stripped of all foliage, cut to 50 cm in length and weighed. A weight/height reading was thus obtained as an index of stem strength.

Plants were the shortest (89.4 cm) when grown in soil, perlite, and peat, Table 60. Soil, perlite, and compost produced the tallest plants (86.8 cm) and soil, peat, and compost, (73.3 cm), and soil and compost (73.5 cm) averaged the shortest plants for the Group II snapdragons. Soil, peat, and compost (111.5 cm) and soil, perlite, and compost (98.3 cm) yielded the tallest and shortest plants, respectively, for the Group IV snapdragons.

The mean plant fresh weight ranged from 78.3 g (soil, peat, and compost) to 48.3 g (soil and compost), Table 61. The media had little effect on fresh weight of Group II plants. Soil, peat, and compost (112.3 g) produced Group IV plants more than twice as heavy as plants grown in soil and compost (52.2 g).

The greatest differences in the mean length of flower head or spike occurred between soil and compost (22.9 cm), soil, perlite, and compost (22.9 cm), soil, perlite, and peat (22.8 cm); and soil and peat (19.8 cm), Table 62. Group II snapdragons produced the longest spikes in soil, perlite, and compost (24.5 cm) and the shortest spikes in soil and peat (17.0 cm). In the Group IV snapdragons, spike length was greatest in soil and compost (27.3 cm) and least in soil, perlite, and compost (21.3 cm).

Soil, perlite, peat, and compost (.028 g/cm) yielded plants with the strongest stems as measured by weight/height ratio, Table 63. Plants grown in soil, perlite, and compost (.019) had the smallest ratio. Group IV cultivars produced the largest and smallest weight/height ratios when grown in soil, perlite, peat, and compost (.041 g/cm) and soil, perlite, and compost (.021 g/cm), respectively.

Table 60. Influence of Peat- and Original Compost-Amended Media on the Mean Height of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Mean
	cm	cm	cm
Soil and peat 1:1	78.3	110.3	94.3
Soil and compost 1:1	73.5	109.3	91.4
Soil, peat and compost 2:1:1	73.3	111.5	92.4
Soil, perlite and peat 1:1:1	76.8	102.0	89.4
Soil, perlite and compost 1:1:1	86.8	98.3	92.6
Soil, perlite, peat and compost 2:2:1:1	82.0	113.0	97.5

Table 61. Influence of Peat- and Original Compost-Amended Media on the Mean Fresh Weight of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Mean
	g	g	g
Soil and peat 1:1	42.8	81.5	62.2
Soil and compost 1:1	44.4	52.2	48.3
Soil, peat and compost 2:1:1	45.3	112.3	78.8
Soil, perlite and peat 1:1:1	44.3	69.4	56.9
Soil, perlite and compost 1:1:1	46.9	73.3	60.1
Soil, perlite, peat and compost 2:2:1:1	43.8	71.8	57.8

Table 62. Influence of Peat- and Original Compost-Amended Media on the Mean Flower Head Length of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Mean
	cm	cm	cm
Soil and peat 1:1	17.0	22.5	19.8
Soil and compost 1:1	18.5	27.3	22.9
Soil, peat and compost 2:1:1	18.0	22.8	20.4
Soil, perlite and peat 1:1:1	19.0	26.5	22.8
Soil, perlite and compost 1:1:1	24.5	21.3	22.9
Soil, perlite, peat and compost 2:2:1:1	22.0	22.0	22.0

Table 63. Influence of Peat- and Original Compost-Amended Media on the Weight/Height Ratio of Stems of Two Flowering Groups of Snapdragons

Media	Group II	Group IV	Mean
	g/cm	g/cm	g/cm
Soil and peat 1:1	.014	.030	.022
Soil and compost 1:1	.016	.029	.023
Soil, peat and compost 2:1:1	.016	.035	.026
Soil, perlite and peat 1:1:1	.016	.023	.020
Soil, perlite and compost 1:1:1	.016	.041	.019
Soil, perlite, peat and compost 2:2:1:1	.015	.041	.028

Growth and Foliar Analysis of Miniature Carnations in Compost-Amended Media

The optimum pH range for carnations is 5.5 to 7.0 which is higher than the optimum for many other floricultural crops. Boron, calcium, and potassium are nutrient elements which often require special consideration in carnation culture. Compost might be useful in the culture of carnations since it has a high pH and contains considerable amounts of boron, calcium, and potassium.

Miniature carnations (Dianthus caryophyllus L.) were selected for these experiments because they can be grown at a higher temperature than standard carnations, thus are better suited to Southern culture. The cultivars, 'Elegance' and 'White Elegance', were selected since current nutrient level standards for miniature carnations are based on 'Elegance' cultivars.

In one experiment media treatments were as shown in Table 64. Alive compost is a product of the Lone Star Organic Plant, Houston, Texas. Ten 15 cm pots of each of the two 'Elegance' cultivars were planted in each media on August 7. Plants were fertilized by watering with a solution containing 200 ppm nitrogen and 160 ppm potassium. Plants were grown in an air-conditioned greenhouse with the temperature maintained between 16 and 21°C.

Foliar analysis samples were taken on October 10. At the time of sampling, plants grown in Alive compost had not produced enough leaves for an adequate sample. All the leaf tissue above the fifth node was taken for tissue analysis. All plants had at least 7 pair of leaves at the time of sampling. The leaves were dried in a forced draft oven at 80°C for 24 hours. When dry, the tissue was ground in a Wiley Mill to pass through a 20-mesh screen. Analysis of the tissue samples were made for nitrogen, phosphorus, potassium, calcium, magnesium, sodium, zinc, manganese, iron, copper, boron, and aluminum.

Five months after planting, the dry weight of five plants per treatment was obtained for each cultivar. Plants were cut at the soil line, placed in paper bags, dried in an oven at 80°C for 24 hours and then weighed.

The growth of plants in compost was not as good as the growth of plants in the soil, peat and perlite, Fig. 22. Plants grown in Alive compost appeared stunted. The mean dry weight of plants grown in Alive compost was 7.4 g, in Mobile Aid 24.0 g, and in the soil mixture 27.1 g, Table 64.

Table 64. Mean Dry Weight of cv. 'Elegance' and cv. 'White Elegance' Carnations Grown in Unamended Composts and Unamended Soil Mixture

Media	Cultivar 'Elegance'	 'White Elegance'	Mean
	g	g	g
Alive compost	7.0	7.7	7.4
Mobile Aid compost	26.1	21.9	24.0
Soil, peat and perlite 1:1:1	30.8	23.4	27.1

Foliar analyses of plants grown in Mobile Aid and in soil, peat and perlite are presented in Table 65. Plants grown in Mobile Aid contain more potassium, calcium, zinc, sodium, and boron than plants grown in soil, peat and perlite. Plants grown in a soil, peat, and perlite mixture contained more nitrogen, phosphorus, magnesium, sodium, manganese, iron, and aluminum than plants grown in Mobile Aid.

Table 65. Foliar Analysis of 'Elegance' Carnations Grown in Compost and in Amended Soil Media[1/]

Media	N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B	Al
Mobile Aid compost	3.60	.44	5.32	3.07	.62	318	835	72	74	15	108	64
Soil, peat, and perlite	4.22	.79	4.93	1.73	.90	660	505	144	98	16	46	112

[1/] Figures represent means of 2 cultivars, 'Elegance' and 'White elegance'.

An experiment utilizing Mobile Aid as a soil amendment for carnation culture in greenhouse benches was established on August 7. The media treatments

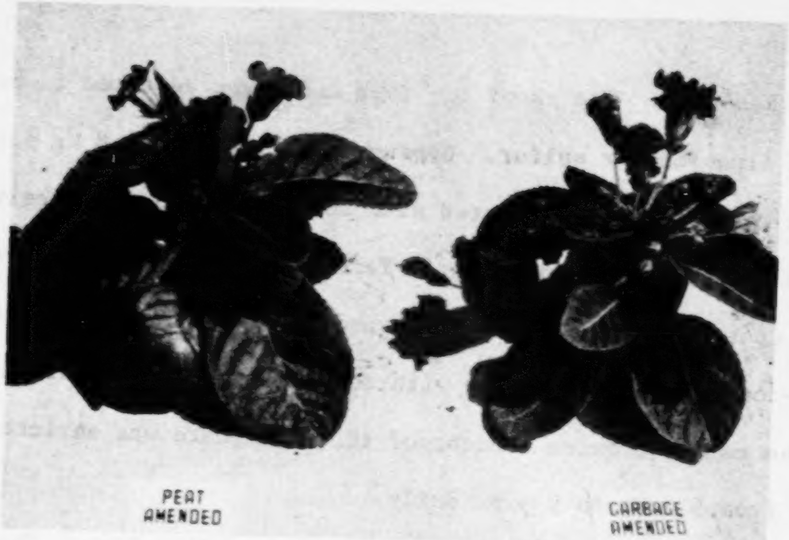
PEAT
AMENDED
GARBAGE
AMENDED

Fig. 21. Difference in leaf size and shape of Gloxinnias grown in peat- and original compost-amended media.

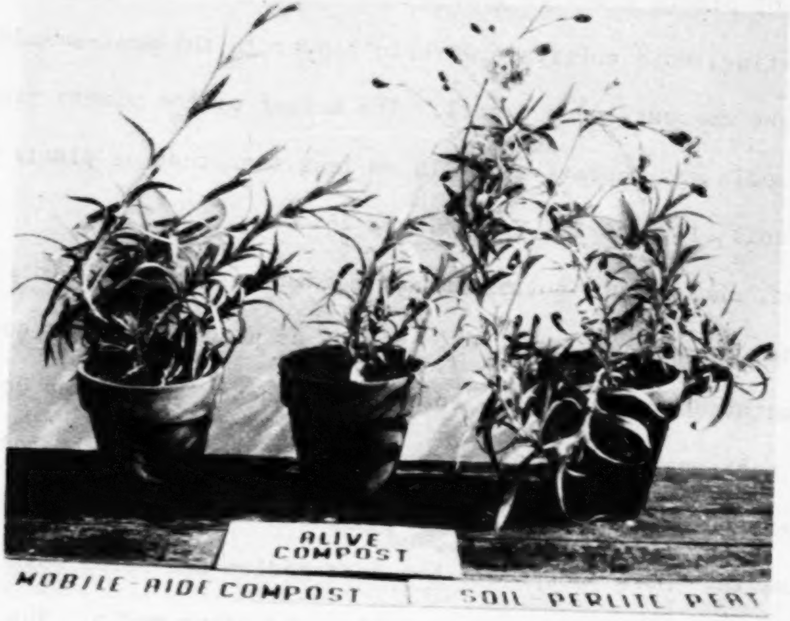
ALIVE
COMPOST
MOBILE-AIDE COMPOST
SOIL PERLITE PEAT

Fig. 22. Growth of miniature carnations five months after planting in two unamended composts and a soil, perlite and peat media.

were as given in Table 66. The pH of the four media was adjusted to 6.5 using either dolomitic limestone or sulfur. Gypsum at the rate of 0.8 kg per 1 m^3 was added to the media that was adjusted with sulfur. All media received superphosphate at the rate of 1.6 kg per 1 m^3. Fertilization consisted of watering with a solution containing 200 ppm nitrogen and 160 ppm potassium. Plants were grown in an air-conditioned greenhouse with the temperature maintained between 16 and 21°C. The carbon dioxide content of the atmosphere was enriched with a CO_2 generator from 5 a.m. to 9 p.m. daily.

Treatments were randomized in blocks with three replications. The two 'Elegance' cultivars appeared in each treatment. Leaf samples were collected 64 days after planting of the rooted cuttings and prepared for spectrographic analysis.

Early growth of plants grown in compost-amended media was retarded. Four months after planting, both cultivars were in flower in the peat-amended soil but were not in the compost-amended soil. The height of the plants grown in compost-amended media was approximately 15 cm less than that of plants grown in peat-amended soil, Figures 23, 24, 25, and 26.

More nitrogen, phosphorus, potassium and magnesium were found in plants grown in peat than in compost, Table 66. Tissue of plants grown in compost-amended media contained more calcium, sodium, manganese, copper and boron than plants grown in peat-amended media. Plants grown in soil and peat contained the most nitrogen, potassium, magnesium and aluminum but the least calcium of the media treatments. More phosphorus but less sodium and boron were found in plants grown in soil, perlite, and peat than the other media. The tissue of plants grown in soil and compost contained more sodium and boron but less magnesium than the other treatments.

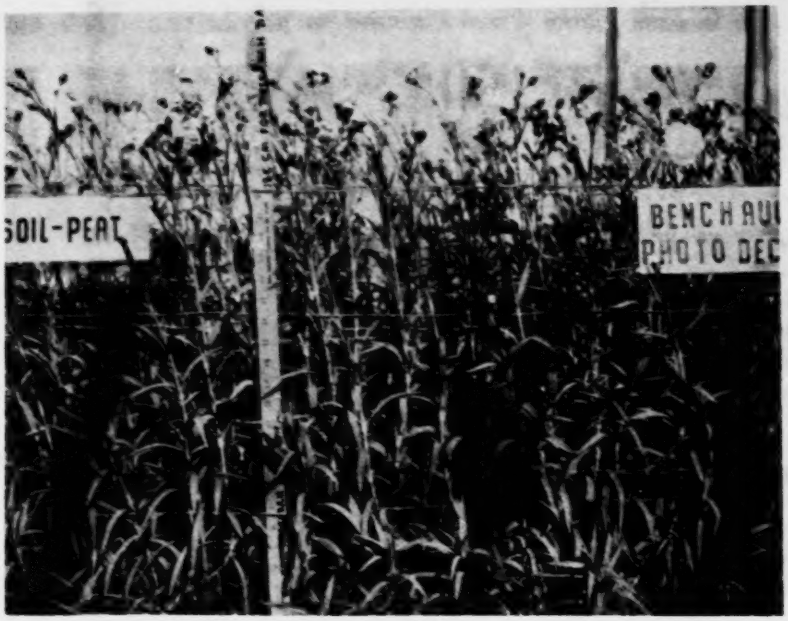
SOIL-PEAT
BENCH AU
PHOTO DEC

Fig. 23. Growth of miniature carnations in soil and peat media 4 months after planting.

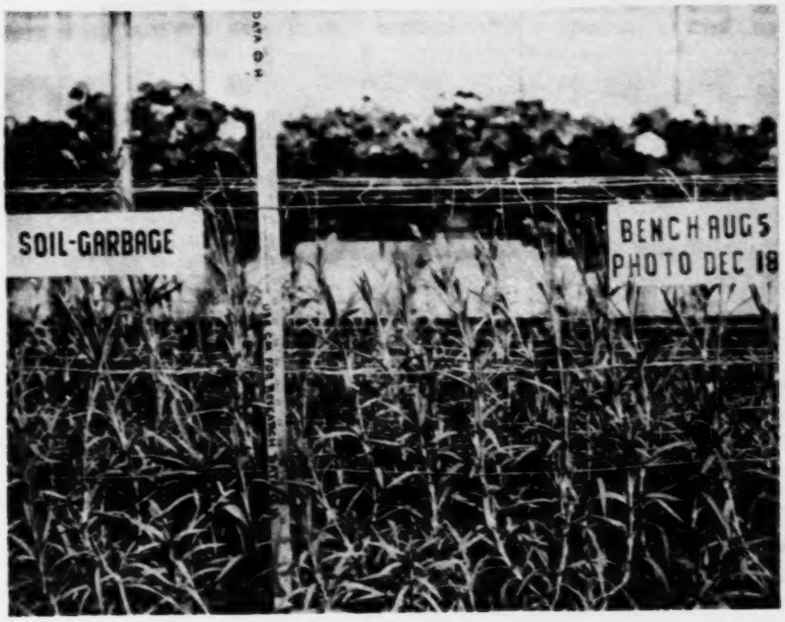
SOIL-GARBAGE
BENCH AUG 5
PHOTO DEC 18

Fig. 24. Growth of miniature carnations in soil and garbage compost media 4 months after planting.

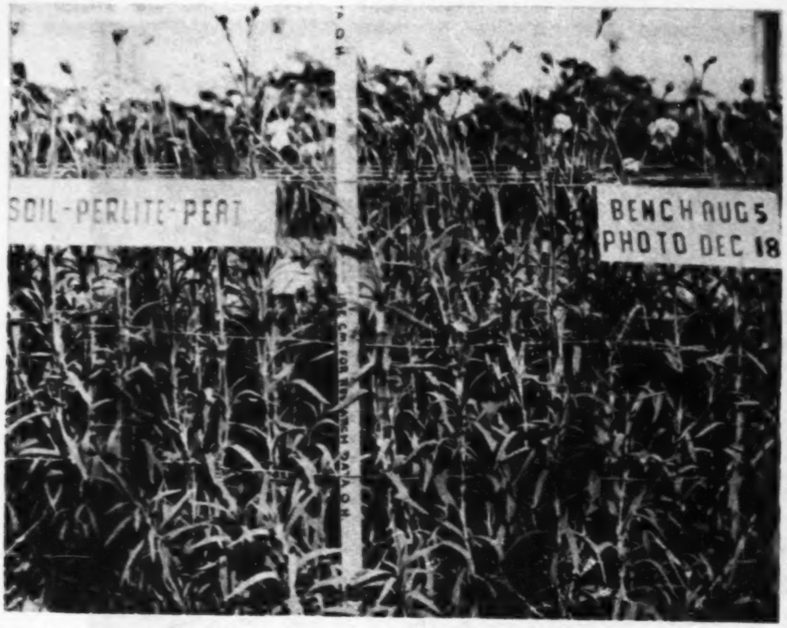
SOIL-PERLITE-PEAT
BENCH AUG 5
PHOTO DEC 18

Fig. 25. Growth of miniature carnations in soil, perlite and peat media 4 months after planting.

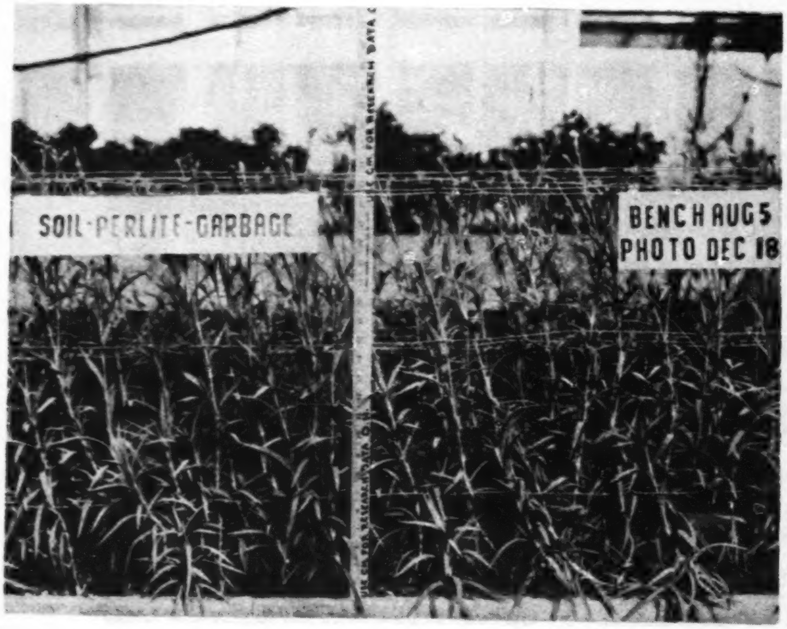
SOIL-PERLITE-GARBAGE
BENCH AUG 5
PHOTO DEC 18

Fig. 26. Growth of miniature carnations in soil, perlite and garbage compost media 4 months after planting.

Table 66. Foliar Analysis of Miniature Carnations Grown in Peat- and Mobile Aid Compost-Amended Media[1]

Media	Per cent by weight					Concentration in ppm						
	N	P	K	Ca	Mg	Na	Zn	Mn	Fe	Cu	B	Al
Soil and peat 1:1 .	3.90	.65	4.57	1.34	.87	730	575	290	87	12	70	108
Soil and compost 1:1 . .	3.41	.44	4.31	2.12	.52	2622	646	335	86	15	145	88
Soil, perlite and peat 1:1.	3.75	.69	4.47	1.45	.72	457	654	262	93	12	65	83
Soil, perlite and compost 1:1 .	3.29	.45	4.18	2.31	.59	1382	608	365	89	15	128	89

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[1] Figures represent means of two cultivars, 'Elegance' and 'White Elegance' replicated three times.

Plants grown in soil, perlite, and compost contained the most calcium but the least nitrogen and potassium of the four media. According to standards established by Nelson and Boodley, all plants were low in nitrogen but contained sufficient amounts of phosphorus, potassium, calcium and magnesium.

Effect of Various Additions and Recomposting on the Chemical Analysis of Original Compost

Phytotoxicity was observed in plants grown in compost-amended media. The margin of older leaves of chrysanthemums, petunias, and snapdragons appeared burned or scorched when grown in garbage compost media. Poor leaf color, resembling nitrogen deficiency, was often observed. Tests revealed that original compost contained excessive soluble salts, low nitrogen and phosphorus and high pH. Some of the problems encountered resembled those reported in saline and alkali soils.

To investigate these problems, experiments were conducted on recomposting with various chemical additions used in garden composting or in amending alkali soils.

Mobile Aid compost which had been composted at the processing plant for an estimated 12-16 weeks was mixed with various chemicals to lower the pH and soluble salts and increase fertility. Spurway analysis of the Mobile Aid prior to treatment revealed nitrates 0-2 ppm, phosphorus 0-1 ppm, potassium 20-40 ppm, and calcium 150-300 ppm. The compost had a pH of 8.6 and a soluble salt reading of 70 mhos (1:5 dilution). Treatments are shown in Table 67. Following treatment, the Mobile Aid was recomposted for 3 months. Every 2 weeks the treatments were moistened and remixed in a cement mixer. Recomposting was conducted in wooden baskets.

Table 67. Spurway Analysis, pH and Soluble Salts of Mobile Aid Compost 3 Months after Treatment

	Spurway analysis (ppm)					Soluble
Treatment	NO_3	P	K	Ca	pH	salts(mhos)
1.6 kg 8-8-8 Fertilizer per m^3 plus -						
0.4 kg Sulfur	10	1	20-40	200	7.2	34
2.4 kg $AlSO_4$	10	1	20-40	200	8.2	29
2.4 kg $FeSO_4$	10	0.5	20-40	200	8.5	31
2.4 kg $MgSO_4$	5-10	1	20-40	200	8.5	30
2.4 kg NH_4SO_4	10	1	20-40	200	8.1	29
0.8 kg Lime-sulfur	2-5	1	20-40	200	8.5	33
0.8 kg $CaSO_4$	5-10	1	20-40	200	8.4	34
1.6 kg NH_4SO_4, 0.8 kg $Ca(H_2PO_4)_2$, 0.4 kg KCl, 0.1 kg $MgSO_4$ and 0.1 kg NaCl per m^3 plus -						
0.8 kg $CaMg(CO_3)_2$	25	1	20-40	200	8.3	33
0.4 kg Sulfur	10-25	1	20-40	200	8.2	28
2.4 kg $AlSO_4$	10-25	1	20-40	200	8.1	30
2.4 kg $FeSO_4$	10	1	20-40	200	8.1	30
2.4 kg $MgSO_4$	10	1	20-40	200	8.2	26
2.4 kg NH_4SO_4	10-25	0.5	20-40	200	8.2	30
0.8 kg Lime-sulfur	5-10	0.5	20-40	200	8.2	27
0.8 kg $CaSO_4$	10-25	1	20-40	200	7.9	27
No treatment						
Control	2-5	0.5	20-40	200	8.6	31

Nitrate levels were increased to 10-25 ppm when the fertilizer consisting of NH_gSO_4, $Ca(H_2PO_4)_2$, KCl, $MgSO_4$, and NaCl plus either $CaMg(CO_3)_2$, sulfur, $AlSO_4$ or $CaSO_4$ was added to the compost, Table 67. Combinations of 8-8-8 fertilizer plus other chemicals did not raise the nitrates above 10 ppm. Recomposted Mobile Aid, which received no chemical treatment had 2-5 ppm nitrates. Phosphorus and potassium were not influenced by treatment. All treatments had 200 ppm calcium. The pH of the compost resisted change. Recomposted Mobile Aid without chemical treatment had a pH of 8.6. The greatest change in pH occurred with the addition of 8-8-8 fertilizer plus sulfur which resulted in a pH of 7.2. The NH_4SO_4 fertilizer plus $CaSO_4$ reduced the pH to 7.9. In all treatments, soluble salts decreased from 70 mhos to 26-34 mhos. Leaching was probably responsible for this reduction since the unamended check had a reading of 31 mhos. Chemical treatment had little effect on soluble salts.

Original Compost as a Mulch for Ornamentals

The use of compost as a mulch is of interest since the large quantities of material available could be readily used in park and highway plantings. Homeowners' use of compost mulches would probably be limited by the appearance and odor of the mulch, Fig. 27.

Most processed garbage composts have a dark brown color. Some contain considerable amounts of film and rigid plastic which detracts from the mulch's appearance. Glass is ground to a size that does not present a problem in appearance or handling. The texture may be granular or fibrous depending probably on the stage of decomposition. Compost which contains sewage has an odor even when well composted. Odor problems with sewage-free compost varies with the raw material used, the composting method and, the length of time the material is composted.

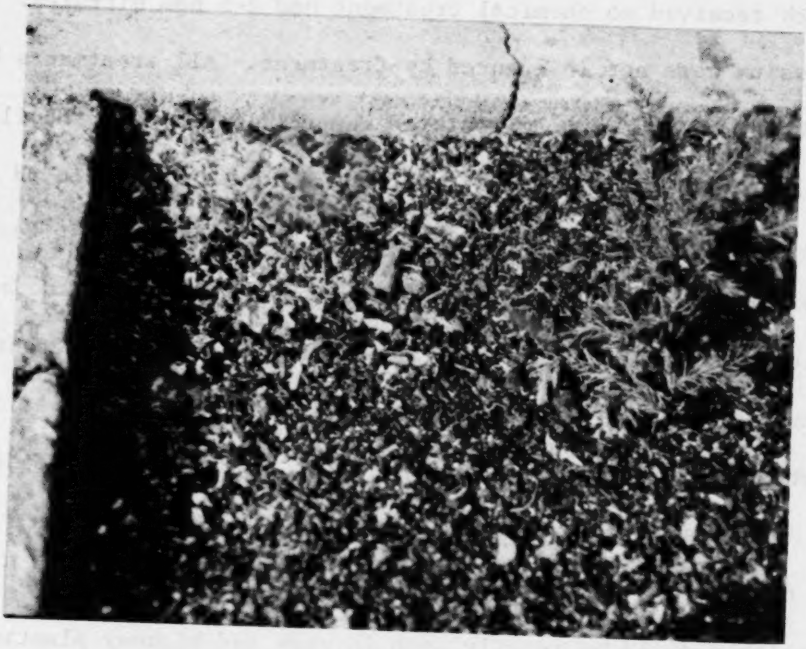

Fig. 27. **Original compost mulch showing accumulation on surface of plastic (light shaded particles).**

Mulching Perennials: Garden Chrysanthemums

Hardy or garden chrysanthemums (Chrysanthemum morifolium Ramat.) were used to test compost as a mulch for the growth of a perennial. Rooted cuttings of 19 cultivars of garden chrysanthemums were potted in 8 cm peat pots containing equal parts of soil, peat and perlite on June 21. Plants were grown in the greenhouse until July 18, when they were transplanted outside into beds at a spacing of 38 cm x 46 cm. Plants were fertilized in the greenhouse each week by watering with a solution containing 1.9 g of 20-20-20 fertilizer per liter of water. Fertilization in the beds consisted of 146 g of 8-8-8 fertilizer per 1 m^2 prior to planting and monthly applications thereafter at the same rate. All plants were pinched three times to increase flower number and growth habit. Pinching was done on June 28, July 18, and August 15.

The three mulch treatments were original compost, sawdust, and pine straw. Each bed contained one cultivar and was divided into three sections with 10 cm aluminum lawn edging. A 2.5 cm mulch was applied to each section using the various mulches. Comparisons were made on each cultivar in each mulch regarding flowering date, height and spread of plants.

The growth of the plants was excellent under all mulch treatments. Leaf and flower color were comparable.

No large differences were noted in the flowering date, height and spread of the plants when grown in the three mulches. Original compost, sawdust, and pine straw mulches produced plants with mean heights of 41.5 cm, 41.3 cm, and 39.8 cm, respectively. The spread of the plants were similar irrespective of mulch treatment. Original compost appeared to be as satisfactory as sawdust or pine straw when used for mulching chrysanthemums.

Mulching Annuals: Petunias

Fifty-four petunia (Petunia hybrida Vilm.) cultivars were planted in a mulching study on annuals. The petunias were produced in the greenhouse by sowing seed in February and transplanting to peat pots containing equal parts of soil, peat, and perlite in March. Plants were planted in beds on April 16.

Fertilization consisted of 146 g of 8-8-8 fertilizer per 1 m^2 of surface incorporated prior to planting and 146 g of 12-6-6 fertilizer per 1 m^2 of rooting bed. Each plot was divided into three sections with 10 cm aluminum lawn edging. The mulch treatments consisted of original compost, sawdust, and pine straw applied to the sections in each plot. Approximately 5 cm of mulching material was applied on May 2.

No apparent differences were observed in the growth and flowering of the petunias with any of the mulches. Leaf and flower color was comparable in all the mulch treatments.

Mulching Woody Ornamentals on the Highway

The establishment, maintenance, and care of plants on highways has become a problem because of the increased use of plants on the highway for esthetic and safety reasons. Mulches can assist in this problem by conserving moisture, reducing weeds, preventing wide fluctuations in soil temperature, and influencing soil nutrition.

An experiment comparing original compost with no mulch, pecan hulls, pine straw, turffiber, and sawdust was established on two roadside locations. Ilex cornuta 'Burford' and Forsythia intermedia were used as test plants. The soil at each site was cultivated to a depth of 15 cm prior to planting of potted Ilex and Forsythia. The mulches were removed the second year and reapplied with the exception of turffiber. Plants were watered immediately after planting and as needed thereafter. Fertilization consisted of a yearly application of 30 ml of 8-8-8 fertilizer sprinkled over the drip line of each plant. Soil moisture and temperature readings were taken May through August. Moisture readings were made with gypsum blocks, located in the center of each mulch treatment at a depth of 15 cm. A telethermometer was used to read the soil temperature as measured by thermister probes located in the center of each mulch plot.

Soil samples were taken from the plots during June of the first year to determine the influence of the mulches on soil nutrition. Soil samples were analyzed for pH, nitrogen, phosphorus, potassium, calcium and magnesium.

Compared to no mulch, all the mulches increased soil moisture, Table 68. Soil mulched with pecan hulls had the highest mean per cent moisture. Lower percentages were observed where pine straw, processed garbage, sawdust and turffiber were used. The slope site had a higher mean moisture reading than the flat site. The proximity of water near the slope and differences in soil type might explain these moisture differences.

Mulching had no effect on the mean soil temperature, Table 69.

Compost mulches raised the pH of the soil almost an entire unit above some of the other mulch treatments, Table 70. In comparison to compost, the other mulches did not influence soil pH.

Compost mulches increased the amount of phosphorus, potassium, calcium, and magnesium in the soil, Table 71. Sawdust mulches reduced soil phosphorus and potassium. Pinestraw mulches resulted in the greatest reduction in soil potassium.

Table 68. Influence of Various Mulches on Per Cent Available Moisture in the Soil at Two Highway Sites[1]

Mulch	Site		
	Flat	Slope	Mean
	%	%	
None	57.4	61.9	59.7
Turffiber	58.5	63.8	61.5
Pecan hulls	62.6	72.2	67.4
Pinestraw	59.6	65.5	62.6
Sawdust	54.4	68.2	61.9
Original compost	60.8	63.9	61.9

[1] Means for readings taken weekly from July 7, 1969 to January 12, 1970.

Table 69. Influence of Various Mulches on Soil Temperature at Two Highway Sites[1]

Mulch	Site		
	Flat	Slope	Mean
	F^{o}	F^{o}	F^{o}
Check	66.7	68.0	67.4
Turffiber	66.6	68.0	67.3
Pecan hulls	67.5	68.1	67.8
Pinestraw	67.1	67.5	67.3
Sawdust	67.4	69.1	68.3
Original compost	67.3	67.7	67.6

[1] Means for weekly reading taken July 7, 1969 to January 12, 1970.

Table 70. Influence of Various Mulches on the Soil pH at Two Highway Sites

Mulch	Site		
	Flat	Slope	Mean
None	5.8	6.3	6.1
Turffiber	5.7	6.2	6.0
Pecan hulls	5.6	6.2	5.9
Pinestraw	5.8	6.3	6.1
Sawdust	5.6	6.2	5.9
Original compost	6.6	6.9	6.8

Table 71. Invluence of Various Mulches on Phosphorus, Potassium, Calcium, and magnesium in the Soil at Two Highway Sites

Mulch	P			K			Ca			Mg		
	Slope	Flat	Mean	Slope	Flat	Mean	Slope	Flat	Mean	Slope	Flat	Mean
	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A	Lb./A
None	21.4	27.8	24.6	101.1	130.0	115.6	882.0	905.0	893.5	105.8	120.0	112.9
Turffiber . . .	20.1	26.8	23.5	189.5	116.5	103.0	901.0	959.0	930.0	105.0	120.0	112.5
Pecan hulls .	22.1	26.4	24.3	208.8	214.3	211.6	851.0	883.0	867.0	111.0	120.0	115.5
Pinestraw . .	21.5	27.0	24.3	85.4	104.9	95.2	899.0	955.0	927.0	111.8	120.0	115.9
Sawdust . . .	15.9	24.1	20.0	88.5	121.9	105.2	951.0	1022.0	986.5	102.0	120.0	111.0
Original compost ..	31.5	33.8	32.7	230.5	216.6	223.6	1204.0	1461.5	1332.8	118.5	120.0	119.3

Original Compost as a Herbicide Mulch

Original compost and sawdust were compared as mulches with and without dichlobenil (2,6-dichlorobenzonitrite) herbicide incorporation on nursery liner production.

Potted liners were planted during July, 1968 in soil bins which contained 125 ft.^{2} per bin. The soil in each bin was prepared by adding 6 ft.^{3} of peat moss, 5 lb. of 8-8-8 fertilizer and 8.5 lb. of dolomitic limestone prior to rototilling. Test plants included Buxus harlandi, Rhododendron obtusum japonicum 'Rose Banner', Juniperus chinensis 'Pfitzer', Viburnum burkwoodi, Ilex cornuta 'Matthew Yates', Juniperus conferta and Thuja pyramidalis. Treatments are given in Table 72. Herbicide was mixed with mulches in a cement mixer prior to application.

Weed coverage was determined on November 20, 1968 and October 17, 1969. The number of plants surviving after the experiment was first established was determined on November 14, 1968. The soil below the treatments was tested to determine treatment effects on soil nutrients. The soil in the plots was sampled on June of 1969 by removing the mulch and taking random core samples throughout the plot.

Check plots, which received no mulch or herbicide, were completely covered with weeds 3 to 4 months after the treatments were applied in both 1968 and 1969, Table 72. The addition of dichlobenil to the mulches decreased the mean per cent weed cover from 43 (no herbicide) to 27 (herbicide). The best weed control was obtained in 1968 with a 2-inch compost mulch plus 6.5 lb. per acre of dichlobenil. A 2-inch sawdust mulch plus 5 lb. per acre of dichlobenil averaged the best weed control in 1969 and for the duration of the experiment. Sawdust, without an herbicide, was quite effective in controlling weeds particularly when applied to a 2-inch depth. Herbicide mulches gave effective control of most broadleaf weeds for approximately 9 months.

Higher percentage plant loss occurred with processed garbage mulches (28.4) than with sawdust mulches (4.4) or no mulch (8.1). Where dichlobenil was used 18.9 per cent of the plants died, whereas 13.9 per cent died where it was not used. The poorest plant survival was observed in plants mulched with two inches of original plus a dichlobenil treatment, Table 73.

Original compost mulches increased phosphorus, potassium, and the pH of the soil, Table 74. Sawdust mulches reduced the soil pH and the phosphorus, potassium, caclium, and magnesium content.

Talbe 73. Influence of Mulch and Herbicide Treatments on Survival of Plants 4 Months After Application

Species	Mulch and Herbicide[1] treatment										
	No mulch or herbicide	No mulch plus dichlobenil	1 in. Sawdust	2 in. Sawdust	1 in. sawdust with dichlobenil	2 in. sawdust with dichlobenil	1 in. original compost with dichlobenil	2 in. original compost with dichlobenil	1 in. original compost with dichlobenil	2 in. original compost with dichlobenil	Mean
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Buxus harlandi ...	7.0	26.7	0.0	13.0	0.0	7.0	66.7	73.3	46.7	86.7	27.0
Rhododendron obtusum japonicum..	0.0	7.0	7.0	0.0	0.0	0.0	13.0	33.3	13.0	60.0	13.0
Juniperus chinensis 'Pfitzer'.........	0.0	0.0	7.0	0.0	0.0	7.0	0.0	20.0	7.0	13.0	5.3
Viburnum burkwoodi	20.0	13.0	7.0	0.0	20.0	13.0	40.0	33.3	73.3	73.3	20.0
Ilex cornuta	0.0	0.0	0.0	0.0	0.0	7.0	0.0	13.0	13.0	0.0	3.3
Juniperus conferta	0.0	13.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	13.0	3.3
Thuja pyramidalis.	13.0	13.0	7.0	20.0	0.0	7.0	13.0	13.0	20.0	46.7	15.3

[1] Dichlobenil was applied at the rate of 4.5 lb/A when applied alone, and 6.5 lb/A when applied in a mulch.

Table 72. Influence of Mulches with and without Dichlobenil Herbicide Incorporation on Weed Control

Treatment	Weed coverage		
	1968	1969	Mean
	Pct.	Pct.	Pct.
No mulch; no herbicide	100	100	100
No mulch; dichlobenil 4.5 lb/A	94	58	76
Sawdust, 1 in.; no herbicide	23	69	46
Sawdust, 2 in.; no herbicide	2	45	24
Sawdust, 1 in.; dichlobenil 6.5 lb/A	30	40	35
Sawdust, 2 in.; dichlobenil 6.5 lb/A	1	16	9
Original compost, 1 in.; no herbicide	17	81	49
Original compost, 2 in.; no herbicide	11	94	53
Original compost, 1 in.; dichlobenil 6.5 lb/A . .	3	85	44
Original compost, 2 in., dichlobenil 6.5 lb/A . .	0	42	21

Table 74. Effect of Various Mulches on Soil pH and Nutrient Content

Mulch and herbicide treatment	pH	Element, per/acre			
		P	K	Ca	Mg
		Lb.	Lb.	Lb.	Lb.
No mulch; no herbicide	6.3	157.6	116.0	486.4	120.0
No mulch; dichlobenil 4.5 lb./A	6.2	143.0	73.4	446.4	120.0
Sawdust, 1 in.; no herbicide	6.0	142.0	63.0	332.8	114.0
Sawdust, 2 in.; no herbicide	6.0	126.0	49.6	331.2	110.4
Sawdust, 1 in.; dichlobenil 6.5 lb/A	6.5	191.2	95.4	374.4	116.8
Sawdust, 2 in.; dichlobenil 6.5 lb/A	6.2	85.0	62.8	373.6	120.0
Original compost, 1 in.; no herbicide	6.4	272.6	113.2	431.2	120.0
Original compost, 2 in; no herbicide	6.5	256.8	151.0	439.2	120.0
Original compost, 1 in.; dichlobenil 6.5 lb/A	6.4	239.2	109.6	409.6	120.0
Original compost, 2 in.; dichlobenil 6.5 lb/A	6.3	263.8	107.4	436.8	118.8

Summary and Conclusions

Compost products of the Municipal Compost Plant of the City of Mobile, Alabama were used in experiments on establishment of grasses on roadsides; for establishment of fine turf grasses; for growth of forage grasses; for alleviation of effects of excessive herbicide applications to soils; as a potting media for ornamentals; and as a mulch for ornamentals. Two composts were used. One contained a small amount of sewage, was coarsely ground and was referred to as original compost. The second contained no sewage, was finely ground and was marketed by the City of Mobile under the name Mobile Aid. The nutrient composition of the two composts were similar. A large amount of plastic was prominent in the original compost but the plastic was not noticeable in the Mobile Aid since it was finely ground.

Conclusions from the experiments were as follows:

1. The composts were deficient in nitrogen and phosphorus when used as a media for plant growth.
2. Plants would grow in the composts without fertilizer additions after the composts had been kept moist for a period of 6 months to 1 year.
3. Toxicity to plants from excessive soil applications of fluometuron and trifluralin was markedly reduced by addition of original compost such that near normal crop growth was obtained within 2 years after herbicide application.
4. Toxicity to plants from excessive soil applications of bromacil and picloram was not alleviated by compost additions.

5. High rates of nitrogen and phosphorus must be added for establishment of grasses on roadsides when large quantities of compost were incorporated before seeding.
6. Where large quantities of composts were added for establishment of grasses on roadsides the growth of plants was excessive the second year after establishment as a result of release of nutrients from the compost.
7. There were indications that compost was exceptionally effective in controlling erosion on steep slopes. (These were observations as no experiments were conducted on erosion).
8. Composts were not as satisfactory as peat in potting media for ornamentals.
9. Mobile Aid compost was generally more satisfactory than original compost for potting media.
10. Foliar analysis of carnations and chrysanthemums grown in compost-amended media revealed high concentrations in the tissue of aluminum, boron, calcium, copper, manganese, potassium, sodium and zinc.
11. Composts were as satisfactory as other materials such as pine straw when used as a mulch for ornamentals.

μσ 600